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Final
Technical Memorandum
Update to Preliminary Remediation Criteria and Closure Strategy for Petroleum-Contaminated Sites
Petroleum Program at Alameda Point
Alameda, California

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Technical Memorandum

Update to Preliminary Remediation Criteria and Closure Strategy for Petroleum-Contaminated Sites
Petroleum Program at Alameda Point
Alameda, California

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Introduction

This technical memorandum (tech memo) presents an update to the original Total Petroleum Hydrocarbon (TPH) Strategy (herein referred to as Petroleum Strategy) and associated preliminary remediation criteria (PRC) that were issued by the Department of the Navy (Navy) in 2001 (Navy, 2001) for corrective action areas (CAA) and other non-CAA (e.g., potential petroleum-impacted areas not included in the Petroleum Program or the Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Program) at Alameda Point. The original Petroleum Strategy has been provided in Attachment 1. The intent of the original Petroleum Strategy was to establish a consensus-based process that incorporated soil and groundwater screening levels protective of human health and marine ecological receptors (i.e., PRCs) that could be applied at all petroleum-impacted sites at Alameda Point to achieve the San Francisco Regional Water Quality Control Board (Water Board) low-risk criteria for fuel sites (Water Board, 1996). If the Water Board low-risk criteria were not met at a site and there were potential risks to human health or marine ecological receptors, then additional investigation or corrective action was considered.

For this update to the Petroleum Strategy, the overall intent remains the same as the original Petroleum Strategy, but the process has been revised to address the Water Board's request that the Navy update the original Petroleum Strategy, including updating the PRCs, and incorporating a comparison of site data to the Water Board Environmental Screening Levels (ESLs) (Water Board, 2008). The Navy has agreed to do so while keeping the Petroleum Strategy streamlined so as to continue efficient site evaluation. The Navy recognizes the ESLs as a useful tool to conduct a preliminary screen of sites to determine whether they can be closed with No Further Action (NFA). The Water Board's ESL document specifically states it "is not intended to establish policy or regulation" and that "the use of ESLs as final cleanup levels for petroleum-related compounds that are known to be highly biodegradable may be unnecessarily conservative." The ESLs serve as a primary screen and the PRCs are a secondary screen (see Steps 4 and 5 below). Remediation goals will be determined on a site-specific basis.

Since the original 2001 Alameda Point Petroleum Strategy was issued, there have been revisions to some of the source documents supporting the soil and groundwater PRCs identified in the original Petroleum Strategy; therefore, the updated Petroleum Strategy includes revised PRCs based on these more recent source documents. The Navy also has updated the Petroleum Strategy by including additional chemicals of potential concern (COPCs) related to petroleum products such as polycyclic aromatic hydrocarbons (PAHs) that may have been associated with historical activities. Additional details regarding these changes are provided in subsequent text of this tech memo.

In keeping with a streamlined approach, the updated Petroleum Strategy has been condensed to include one strategy to address potential petroleum-impacted soil and groundwater in either CAA or non-CAA; whereas in the original Alameda Point Petroleum Strategy there were four strategies outlined: (1) soil in CAA; (2) soil in non-CAA; (3) groundwater in CAA; and (4) groundwater in non-CAA. Therefore,

Figure 1 in the updated Petroleum Strategy replaces Figures 1 through 4 of the original Petroleum Strategy (Navy, 2001). Similarly, PRCs for human and ecological receptors have been condensed to one table. Thus, Table 3 in the updated Petroleum Strategy replaces Tables 1 through 3 in the original Petroleum Strategy.

The Navy has taken the Water Board's requests into account while developing this update to the Petroleum Strategy and looks forward to working with the Water Board as well as the California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC) and United States Environmental Protection Agency (U.S. EPA) as applicable, to achieve no further action and closure for sites in the Petroleum Program at Alameda Point. Responses to comments on the draft version of this tech memo are provided in Attachment 6. The Water Board requested that there be direct coordination between the Petroleum and CERCLA programs where appropriate and where value to the overall environmental restoration program might be realized. For example, remedial goals that have been established for CERCLA sites will be considered when developing remedial goals for nearby petroleum sites. Additionally, the Navy will evaluate potential contaminant migration and property transfer issues (e.g., remediating to different land re-use goals) between the Petroleum and CERCLA programs. To mitigate the potential for such conflict, the Navy will directly coordinate the Petroleum and CERCLA programs to ensure such issues are tracked and resolved as efficiently as possible.

Petroleum Strategy for Soil and Groundwater

The Alameda Point Petroleum Program includes areas where fuel products were stored or transported, and includes USTs, ASTs, and their associated piping that contained petroleum only. The steps included in the Petroleum Strategy are shown in the flowchart provided as Figure 1, and are defined as follows:

Step 1 – Remove Surface Staining and Confirm Evidence of Release. Confirm evidence of release, and if present, remove immediate surface staining. Common surface stains from sources such as dripping oil pans or motor vehicle parking are not considered significant, and will not be removed. If there is evidence that a release never occurred (e.g., tank used to store water or tank never used), proceed directly to site closure with NFA. During surface stain removal, if evidence of subsurface contamination is found, then a subsurface investigation will be conducted.

Step 2 – Screen Data for Presence of Free Product (FP). Compare all existing site data from surface soil, subsurface soil, and groundwater samples to FP screening criteria to determine whether FP is potentially present. If FP screening criteria are exceeded, conduct a FP investigation or review results of previous investigations to determine whether FP may be present. If measurable FP is present, initiate immediate action toward FP removal .

Step 3 – Screen Data for CERCLA Contaminants. Confirm CERCLA contaminants are not present at concentrations that may present a risk to human health and the environment by screening site data against criteria that are consistent with the Alameda Point CERCLA Program. If CERCLA contaminants are at concentrations that may present a risk and are significantly co-mingled with petroleum-associated compounds, consider transferring the site to the CERCLA Program.

Step 4 – Screen Site Data Against ESLs. Sites that are adequately characterized (see Step 6) at or below ESLs can be closed with no further evaluation, investigation, or action.

Step 5 – Screen Site Data Against PRCs. Sites that are adequately characterized (see Step 6) at or below PRCs that are calculated to be protective of human health and the environment can be closed with NFA. Sites characterized slightly above PRCs can be closed with NFA if sufficient technical justification exists, otherwise additional investigation may be warranted. Sites characterized above PRCs may require further evaluation, investigation, or corrective action before closure.

Step 6 – Confirm Adequate Site Characterization. Confirm soil and groundwater samples have been collected from areas of known releases or from the vicinity of known or potential sources (e.g., storage tanks). Samples should be biased towards anticipated locations of highest concentrations and potential preferential pathways such as subsurface utility corridors (e.g., storm drain, electrical conduits, etc). Groundwater data should be collected both at the source and downgradient from the known or suspected source. The usability of the analytical data needs to be confirmed (e.g., analytical methods appropriate for detecting chemicals of potential concern and detection limits adequate for comparison to screening values). Further site characterization may include, but not be limited to, additional sampling, consideration of ambient levels in the environment, a detailed assessment of the assumptions made in calculating the screening-level values, or fate and transport modeling.

Step 7 – Determine Need for Corrective Action. Risk management considerations are used to determine if a corrective action is warranted. For example, if numerous samples were collected at a site and only a few of those samples had concentrations slightly above the PRC, then a corrective action may not be warranted. Risk management decisions also may include decisions to block or monitor an exposure pathway (e.g., repairing storm drains or monitoring potential chemical migration with sentry wells [i.e., wells located between the source of contamination and the exposure point]) to prevent threat of exposure. If risk management considerations favor a corrective action, then corrective action alternatives will be evaluated in a Corrective Action Plan (CAP).

The steps outlined above and summarized in Figure 1 will be applied at all CAA and non-CAA petroleum sites at Alameda Point in order to identify those that can be closed with NFA, and those requiring additional data collection or potentially corrective action. The remainder of this technical memorandum provides a summary of the Petroleum Program COPCs and associated screening levels (i.e., ESLs and PRCs) that the Navy will use to screen data from all petroleum-related sites at Alameda Point. Note that all PRCs identified in this tech memo are intended to be screening criteria that can be used to further evaluate petroleum sites at Alameda Point. PRCs are not to be considered cleanup goals. If during Step 7 of the Petroleum Strategy it is determined that corrective action is warranted at a particular site, site-specific cleanup goals should be developed in a CAP.

Determination of Chemicals of Potential Concern

Site-specific COPCs are identified based on the typical constituents, components, additives, impurities, and degradation products of the petroleum product that was known or suspected to have been released at the site, or associated with various types of historical activities conducted by the Navy at the base. Table 1 summarizes the COPCs included in the Alameda Point Petroleum Strategy and illustrates what distillate range (i.e., light, middle, and heavy petroleum distillates, and waste oil) the chemical is typically associated with based on information provided in ASTM E 1739-95 (Reapproved in 2002). If light distillates such as gasoline were stored at a petroleum site, Table 1 shows that volatile organic compounds (VOCs) including benzene, toluene, ethylbenzene, xylenes (BTEX), methyl-tert-butyl ether (MTBE) and 1,2-dichloroethane, lead, and total petroleum hydrocarbons in the gasoline range (TPH-G) will be evaluated. If middle distillates such as diesel or jet fuel were stored at a petroleum site, VOCs, polycylic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons in the diesel and jet fuel range (TPH-D and TPH-JF, respectively) will be evaluated. If heavy distillates such as motor oil were stored at a petroleum site, PAHs, total petroleum hydrocarbons in the motor oil range (TPH-MO), lead, and chlorinated hydrocarbons, polychlorinated biphenyls (PCBs) and heavy metals as applicable based on the past uses at the petroleum site. If waste oil was stored at a petroleum site, which is assumed to potentially consist of a mixture of light, middle, and heavy distillates, all of the COPCs listed above will be evaluated.

TPH is a mixture of several hundred chemical compounds and varies considerably even within each fraction (e.g., TPH-G, TPH-JF, TPH-D, TPH-MO). The toxicity of TPH is difficult to estimate because it is a mixture of compounds. As such, TPH concentration data cannot be used to accurately and directly estimate risk. The same concentration of TPH may represent very different chemical compositions and very different risks to human health and the environment (TPH Criteria Working Group [TPHWG], 1997). Typically, risks from TPH are evaluated by focusing on surrogate organic compounds that are within the same carbon range as the TPH present at a particular site. For example, the surrogate compound for determining risk due to TPH-G is n-hexane, and the surrogate compound for TPH-JF, TPH-D, and TPH-MO is naphthalene. The updated Petroleum Strategy presents PRCs for the TPH fractions even though these data do not directly quantify potential risks to human health and the environment. The primary reason for including TPH PRCs is so that historical TPH data may be evaluated. Future data collection under the Alameda Point Petroleum Program does not require TPH analyses to identify associated risks because the more prevalent and toxic components of TPH will be individually analyzed for and evaluated under the VOC and PAH analyses. Specifics regarding future data collection will be discussed and determined in consultation with the Water Board, during the development of sampling and analysis plans and the associated data quality objectives for future data collection efforts. If the future collection of TPH data is determined to be useful, the groundwater samples should be filtered to remove non-dissolved petroleum and have silica gel cleanup performed to remove polar non-hydrocarbon compounds.

Inorganic lead rather than organic lead is identified as a COPC. Though lead was typically added to gasoline either as tetraethyl or tetramethyl lead (i.e., organic forms of lead), and may still be found in its original organic form in areas containing FP, outside FP zones these materials typically decompose to inorganic forms of lead (ASTM, 2002). If present, FP will be removed in Step 2 of the Petroleum Strategy and therefore subsequent steps of the strategy should evaluate inorganic lead.

Screening Criteria

<u>Free Product</u>

The FP screening criteria applied in Step 2 of the Petroleum Strategy (see Figure 1) were developed to assess whether further investigation of FP at a site is needed. FP is considered to be a continuing source of groundwater contamination and may pose a potential hazard (e.g., if encountered during excavation or during transport through storm drains). There has been no change in the FP criteria since the 2001 Petroleum Strategy. For soil, the saturation concentration of 14,000 milligrams per kilogram (mg/kg) was selected as the TTPH screening level. For groundwater, the groundwater solubility limit of 20 milligrams per liter (mg/L) was chosen as the TTPH screening level.

<u>Water Board ESLs</u>

ESLs include both risk-based and non-risk-based values that were derived by the Water Board to protect human health and the environment. The Water Board ESL document states that ESLs are considered to be conservative and that active remediation may or may not be required depending on site-specific conditions even if chemicals are present at concentrations above the corresponding ESL (Water Board, 2008). The ESLs were developed to address environmental protection goals for various media including:

Surface Water and Groundwater:

- Protection of drinking water resources;

- Protection of aquatic habitats;
- Protection against vapor intrusion into buildings;
- Protection against adverse nuisance conditions.

Soil:

- Protection of human health (direct exposure);
- Protection against vapor intrusion into buildings;
- Protection against leaching and subsequent impacts to groundwater;
- Protection of terrestrial biota;
- Protection against adverse nuisance conditions.

The ESLs are presented in a series of tables in the Water Board ESL document (Water Board, 2008). Each table reflects a specific combination of soil, groundwater and land-use characteristics that strongly influence the magnitude of environmental concerns at a given site. This allows the user to select ESLs that are most applicable to a given site. The lowest of the individual screening levels for each chemical and environmental exposure concern was selected for screening petroleum data at Alameda Point (see Step 4 in Figure 1). This ensures that the ESLs used to screen the data are protective of all potential environmental concerns and provides a tool for rapid screening of site data. For the Petroleum Strategy at Alameda Point, the ESLs obtained from Tables A and B in the Water Board ESL document will be used to screen the data. ESLs from Table A of the Water Board ESL document are derived for areas with shallow soil (approximately 10 ft bgs) contamination and where groundwater is a potential source of drinking water. ESLs from Table B of the Water Board ESL document are derived for areas with shallow soil (approximately 10 ft bgs) contamination and where groundwater is not a potential source of drinking water. Table 2 provides a summary of the ESLs that will be used for screening petroleum data at Alameda Point under Step 4 of the Petroleum Strategy (see Figure 1).

Soil PRCs

Soil PRCs are selected for each site based on proposed land reuse reflected in the Preliminary Development Concept (PDC) (Alameda Reuse and Redevelopment Authority [ARRA], 2006) and potentially complete exposure pathways. Soil PRCs listed in the 2001 Petroleum Strategy were based on the U.S. EPA Region 9 PRGs for residential and non-residential exposure scenarios. Region 9 PRGs have since been harmonized with similar risk-based screening levels used by U.S. EPA Regions 3 and 6 into a single table: "Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites" (U.S. EPA, 2009). Therefore, the soil PRCs have been updated to reflect the most current RSLs. Table 3 summarizes the PRCs for soil that will be applied in Step 5 of the Petroleum Strategy (see Figure 1).

The non-residential PRC screening value for lead has been updated. Consistent with the 2001 Petroleum Strategy of using U.S. EPA Region 9 PRGs when available, the non-residential lead screening value of 800 mg/kg has been selected as the updated PRC, which is the current value listed in the U.S. EPA RSL table (U.S. EPA, 2009). For the residential PRC, a tech memo was issued by the Navy in December 2008 (Navy, 2008), which describes the process that was applied in developing a lead screening value of 319 mg/kg. Attachment 2 contains a copy of the lead tech memo. This screening level was derived using LeadSpread 7 (Cal/EPA, 2000) and includes the homegrown produce exposure pathway and incorporates site-specific characteristics of Alameda Point. However, the regulatory agencies have expressed some concern regarding potential inconsistencies that could be created with residential soil remedial goals for lead that have been applied on CERCLA remedial actions at Alameda Point. At the time of the printing of this tech memo, the California DTSC suggests the use of a residential soil lead PRC of 150 mg/kg, but also indicates that they are conducting additional evaluations. The Navy has decided to leave the residential soil lead PRC as "TBD" until additional information is available from DTSC's review, and a consensus can be reached with the regulatory agencies.

As in the 2001 Petroleum Strategy, PRCs for the TPH fractions (-G, -D/JF, -MO) are based on values derived for the Presidio of San Francisco ("Presidio" values) (Montgomery Watson, 1996), and have been updated to reflect current CalEPA toxicity values and proposed land reuse reflected in the Preliminary Development Concept (PDC) (ARRA, 2006). The Presidio values were developed using a surrogate approach whereby the TPH data were conservatively assumed to represent extractable petroleum hydrocarbon fractional ranges (aliphatic and aromatic compounds) and assigned an appropriate surrogate chemical for which a risk-based action level had already been determined. The updated TPH PRCs have incorporated U.S. EPA's residential and industrial RSLs as the risk-based action levels for the surrogate chemical. Attachment 3 provides a summary of the updated TPH PRC calculations.

Groundwater PRCs

Groundwater PRCs are selected for each site based on proposed land reuse reflected in the PDC (ARRA, 2006), groundwater designation, and potentially complete exposure pathways. In the 2001 Petroleum Strategy, exposures to COPCs in groundwater were considered via ingestion and inhalation of indoor air for human receptors. Potential discharge of groundwater to surface water was considered as an exposure pathway of concern for marine ecological receptors.

For ingestion of groundwater, the 2001 PRC for benzene, toluene, ethylbenzene, xylenes, MTBE, and lead was the California maximum contaminant level (MCL) because in all cases it was more stringent than the federal MCL. Therefore, these PRCs have been updated to reflect the most current California MCL. For COPCs not having a MCL, the 2009 U.S. EPA RSL for tap water was selected as the PRC. The Water Board issued a letter on July 21, 2003 (Water Board, 2003), concurring that groundwater west of Saratoga Street at Alameda Point meets the exemption criteria in the State Water Resources Control Board Source of Drinking Water Policy Resolution 88-63, and San Francisco Bay Regional Water Quality Control Board Resolution 89-39. Attachment 4 contains a copy of the Water Board letter. As a result of this letter, PRCs for groundwater ingestion in areas west of Saratoga Street are not applicable.

The PRC for inhalation of indoor air was originally determined using the Johnson & Ettinger (J&E) model. Thus, PRCs for indoor air have been revised to reflect the use of the more current DTSC-modified J&E model (version 3.0 last modified on January 21, 2005) and toxicity values reflective of the U.S. EPA's RSLs (2009). Several of the PAH COPCs (acenaphthene, fluorene, naphthalene, 2-methylnaphthalene, pyrene, and chrysene) are considered to be volatile based on their chemical properties; however, naphthalene is the only PAH for which an indoor air PRC was determined. Results of the J&E model for all of the volatile PAH COPCs except naphthalene indicated that the groundwater concentration would have to be above the COPC's solubility limit to have an unacceptable indoor air risk. At the solubility limit all of the volatile PAH COPCs except naphthalene would not present an indoor air risk. Attachment 5 provides a summary of the input parameters used in the J&E model as well as an example input/output form from the model.

The majority of the 2001 PRCs for marine ecological receptors were obtained from the National Oceanic and Atmospheric Administration (NOAA) 1999 Screening Quick Reference Tables (SQuiRTs). The MTBE PRC was an interim water quality objective provided by the Water Board (Water Board, 1998), and the Total TPH PRC was derived from bioassay testing of ecological receptors in San Francisco Bay (TtEMI, 1997). Accordingly, all PRCs, except Total TPH, have been updated with values from the most recent NOAA SQuiRTs (Buchman, 2008). NOAA SQuiRTs do not include a value for Total TPH; therefore, the Total TPH value is the same as the value in the original Petroleum Strategy. As stated in

Buchman (2008), the SQuiRT values are used by NOAA as preliminary screening levels to identify substances which may threaten natural resources and do not constitute criteria or clean-up levels.

Table 3 provides a summary of the updated PRCs for groundwater that will be applied in Step 5 of the Petroleum Strategy (see Figure 1).

PRCs developed for potential exposures to marine ecological receptors through groundwater discharging to surface water at multiple distances upgradient of the shoreline are provided for benzene, MTBE, lead, and Total TTPH as was provided in the original Petroleum Strategy. Values for benzene and MTBE have been revised to reflect their updated marine ecological PRC (listed in Table 3). Table 4 provides a summary of the updated PRCs for multiple distances away from the shoreline that will be applied as appropriate to COPCs in groundwater in Step 5 of the Petroleum Strategy (see Figure 1).

Special Considerations Associated with PRCs

DTSC issued Human Health Risk Assessment (HHRA) Note 3 on May 6, 2009, which presents their recommended methodology for use of U.S. EPA RSLs in the HHRA process at Department of Defense sites and facilities. DTSC HHRA Note 3 states that some of the U.S. EPA RSLs "differ significantly (greater than four-fold) from values calculated using CalEPA toxicity criteria and risk assessment procedures", and it presents a table of values for specific chemicals that they recommend for use instead of the U.S. EPA RSLs. The updated Petroleum Strategy takes these recommendations into account and applies PRCs that are consistent with the values presented in DTSC HHRA Note 3. PAHs were the only chemical class affected by this DTSC HHRA Note 3, and specifically includes acenaphthene, anthracene, chrysene, fluorine, and pyrene.

Acronyms and Abbreviations

ARRA	Alameda Reuse and Redevelopment Authority
ASTM	American Society for Testing and Materials
BTEX	benzene, toluene, ethylbenzene, xylenes
CAA	corrective action area
CalEPA	California Environmental Protection Agency
CAP	Corrective Action Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPCs	chemicals of potential concern
DTSC	Department of Toxic Substances Control
ESL	Environmental Screening Level
FP	free product
HHRA	Human Health Risk Assessment
J&E	Johnson & Ettinger
MCL	maximum contaminant level
MTBE	methyl-tert-butyl ether

Navy	Department of the Navy
NFA	No Further Action
NOAA	National Oceanic and Atmospheric Administration
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDC	preliminary development concept
PRC	preliminary remediation criteria
RSL	regional screening level
SQuiRTs	Screening Quick Reference Tables
TPH	total petroleum Hydrocarbon
TPHCWG	Total Petroleum Hydrocarbon Criteria Working Group
TPH-D	total petroleum hydrocarbons in the diesel fuel range
TPH-G	total petroleum hydrocarbons in the gasoline range
TPH-JF	total petroleum hydrocarbons in the jet fuel range
TPH-MO	total petroleum hydrocarbons in the motor oil range
TtEMI	Tetra Tech EM, Inc.
TTPH	total total petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound
Water Board	San Francisco Regional Water Quality Control Board

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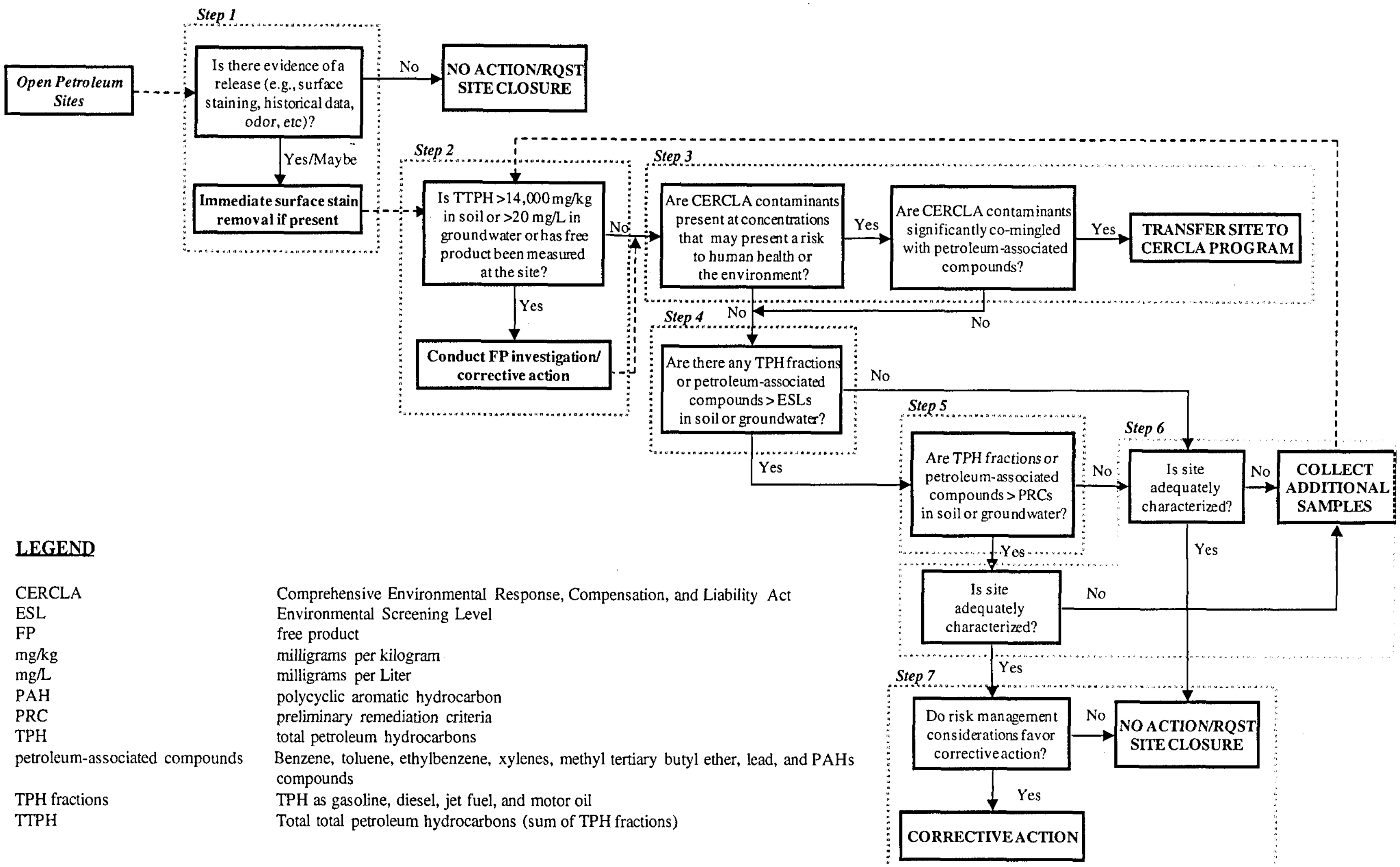

LEGEND

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
ESL	Environmental Screening Level
FP	free product
mg/kg	milligrams per kilogram
mg/L	milligrams per Liter
PAH	polycyclic aromatic hydrocarbon
PRC	preliminary remediation criteria
TPH	total petroleum hydrocarbons
petroleum-associated compounds	Benzene, toluene, ethylbenzene, xylenes, methyl tertiary butyl ether, lead, and PAHs compounds
TPH fractions	TPH as gasoline, diesel, jet fuel, and motor oil
TTPH	Total total petroleum hydrocarbons (sum of TPH fractions)

Figure 1. Petroleum Soil and Groundwater Strategy for Open Petroleum Sites

Table 1. Summary of Chemicals of Potential Concern for Petroleum Products[a]

COPC	Light Distillates	Middle Distillates	Heavy Distillates	Waste Oil
Benzene	X	X		X
Toluene	X	X		X
Ethylbenzene	X	X		X
Xylenes	X	X		X
Methyl Tertiary Butyl Ether (MTBE)	X			X
1,2-dichloroethane (1,2-DCA)	X			
Acenaphthene		X	X	X
Acenaphthylene		X	X	X
Anthracene		X	X	X
Benzo(a)anthracene		X	X	X
Benzo(b)fluoranthene		X	X	X
Benzo(k)fluoranthene		X	X	X
Benzo(a)pyrene		X	X	X
Benzo(g,h,i)perylene		X	X	X
Chrysene		X	X	X
Dibenz(a,h)anthracene		X	X	X
Fluoranthene		X	X	X
Fluorene		X	X	X
Indeno(1,2,3-cd)pyrene		X	X	X
1-methylnaphthalene		X	X	X
2-methylnaphthalene		X	X	X
Naphthalene		X	X	X
Pyrene		X	X	X
TPH-G (C_4-C_{12})	X			X
TPH-D (C_{11}-C_{20})		X		X
TPH-JF (C_9-C_{16})[b]		X		X
TPH-MO (C_{20}-C_{34})			X	X
TPH (Total)	X	X	X	X
Inorganic Lead	X		X	X
Additional COPCs (chlorinated hydrocarbons, PCBs, heavy metals)[c]			X	X

Note: Distillates are products made from crude oil that have been distilled in a refinery and then usually processed and purified further.

(a) Compilation of commonly selected COPCs for petroleum distillates was obtained from information presented in the "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites" (ASTM E 1739-95 (Reapproved 2002).

(b) The carbon ranges listed are as defined by Agency for Toxic Substances and Disease Registry (ATSDR). Some of the carbon ranges overlap each other and TPH-G (C_4-C_{12}) and TPH-D (C_{11}-C_{20}) fully account for TPH-JF (C_9-C_{16}).

(c) Soil and groundwater impacted by releases of heavy distillates and waste oil may also require testing for additional COPCs such as heavy metals, chlorinated solvents, and PCBs.

Table 2. Summary of ESLs Used as Screening Criteria for the Petroleum Strategy at Alameda Point

Chemical	Drinking Water[a]			Non-drinking Water B[a]		
	Residential Shallow Soil (mg/kg)	Commercial Shallow Soil (mg/kg)	Groundwater - as a source of drinking water (µg/L)	Residential Shallow Soil (mg/kg)	Commercial Shallow Soil (mg/kg)	Groundwater - not a source of drinking water (µg/L)
Volatile Organic Compounds						
Benzene	0.044	0.044	1	0.12	0.27	21[c]
Toluene	2.9	2.9	40	9.3	9.3	130
Ethylbenzene	2.3	3.3	30	2.3	4.7	43
Xylenes (Total)	2.3	2.3	20	11	11	100
MTBE	0.023	0.023	5	8.4	8.4	1,800
1,2-DCA	0.0045	0.0045	0.5	0.22	0.48	20
Metals						
Lead	200	750	2.5	200	750	2.5
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	16	16	20	19	19	23
Acenaphthylene	13	13	30	13	13	30
Anthracene	2.8	2.8	0.73	2.8	2.8	0.73
Benzo(a)anthracene	0.15[c]	1.3	0.027	0.15[c]	1.3	0.027
Benzo(b)fluoranthene	0.15[c]	1.3	0.029	0.15[c]	1.3	0.029
Benzo(k)fluoranthene	0.38	1.3	0.029	0.38	1.3	0.4
Benzo(a)pyrene	0.015[c]	0.13	0.014	0.015[c]	0.13	0.014
Benzo(g,h,i)perylene	27	27	0.1	27	27	0.1
Chrysene	3.8[c]	13[c]	0.35	3.8[c]	13[c]	0.35
Dibenz(a,h)anthracene	0.015[c]	0.21	0.0029[c]	0.015[c]	0.21	0.25
Fluoranthene	40	40	8	40	40	8
Fluorene	8.9	8.9	3.9	8.9	8.9	3.9
Indeno(1,2,3-cd)pyrene	0.15[c]	2.1	0.029[c]	0.15[c]	2.1	0.048
1-methylnaphthalene[b]	1.3	2.8	2.3[c]	1.3	2.8	1.4[c]
2-methylnaphthalene	0.25	0.25	2.1	0.25	0.25	2.1
Naphthalene	1.3	2.8	0.14[c]	1.3	2.8	1.4[c]
Pyrene	85	85	2	85	85	2
Total Petroleum Hydrocarbons						
Gasoline	83	83	100	100	180	210
Diesel/Jet Fuel	83	83	100	100	180	210
Motor Oil	370	2,500	100	370	2,500	210
Total TPH	-	-	-	-	-	-

(a) Water Board, 2008 unless otherwise noted. Drinking water values originate from Final ESL Table A, which addresses contamination in shallow soils (≤3 m bgs) and potable groundwater beneath the site. Non-drinking water values originate from Final ESL Table B, which addresses contamination in shallow soils (≤3 m bgs) and nonpotable groundwater beneath the site.

(b) Naphthalene is used as a surrogate for 1-methylnaphthalene.

(c) These screening criteria are identified as PRCs in Table 3 and are less than the comparable ESLs based on different exposure assumptions. For instance the ESLs consider adult-only consumption for tapwater, whereas the 2009 U.S. EPA RSL used to establish PRCs in Table 3 incorporates exposure to an adult and child (i.e., weighted adjustment of exposure factors). To ensure that the comparison to ESLs is conservative, those PRCs in Table 3 that are less than comparable ESLs in this table will be used during the initial ESL screening step.

"-" indicates that there is no value available.

Table 3. Soil and Groundwater Preliminary Remediation Criteria

Chemical	PRC for Soil (mg/kg)		PRC for Groundwater (µg/L)			
	Residential[a]	Nonresidential[a]	Residential Vapor Intrusion[b] from GW	Nonresidential Vapor Intrusion[b] from GW	Residential Ingestion of Water[c]	Marine Ecological Receptors[d]
Volatile Organic Compounds						
Benzene	1.1	5.6	21	36	1	110
Toluene	930	930	305,000	427,000	150	215
Ethylbenzene	5.7	29	56	94	300	25
Xylenes	300	300	42,000	58,900	1,750	100
MTBE	39	190	3,520	5,910	13	5,000
1,2-DCA	0.45	2.2	25	42	5	11,300
Metals						
Lead	TBD[e]	800	-	-	15	8.1
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	3,400	33,000	-	-	370[l]	40
Acenaphthylene	3,400[f]	33,000[f]	-	-	2,200	300
Anthracene	17,000	170,000	-	-	1,800[l]	300
Benzo(a)anthracene	0.15[k]	2.1	-	-	0.029	300
Benzo(b)fluoranthene	0.15[k]	2.1	-	-	0.029	300
Benzo(k)fluoranthene	0.38[l]	1.3[l]	-	-	0.056[l]	300
Benzo(a)pyrene	0.015[k]	0.21	-	-	0.2	300
Benzo(g,h,i)perylene	1,700[g]	17,000[g]	-	-	1,100	300
Chrysene	3.8[k], [l]	13[k], [l]	-	-	0.56[l]	300
Dibenz(a,h)anthracene	0.015[k]	0.21	-	-	0.0029[k]	300
Fluoranthene	2,300	22,000	-	-	1,500	11
Fluorene	2,300	22,000	-	-	240[l]	300
Indeno(1,2,3-cd)pyrene	0.15[k]	2.1	-	-	0.029[k]	300
1-methylnaphthalene	22	99	-	-	2.3[k]	1.4[h]
2-methylnaphthalene	310	4100	-	-	150	300
Naphthalene	3.9	20	53	89	0.14[k]	1.4
Pyrene	1,700	17,000	-	-	180[l]	300
Total Petroleum Hydrocarbons						
Gasoline	950[i]	4,333[i]	-	-	-	-
Diesel/Jet Fuel	429[i]	1,914[i]	-	-	-	-
Motor Oil	600[i]	2,680[i]	-	-	-	-
Total TPH	-	-	-	-	-	1,400[j]

"-" indicates that there is no value available.

(a) Residential and non-residential PRCs in soil have been updated to be consistent with U.S. EPA RSLs issued in April 2009 (http://www.epa.gov/region09/superfund/prg/index.html), unless otherwise indicated.

(b) Vapor intrusion PRC were developed using the DTSC-modified J&E model (version 3.0, last modified February 4, 2009), which includes DTSC-recommended toxicity values. See Attachment 5 for a summary of model input parameters.

(c) Drinking water PRC are based on California MCLs for benzene, toluene, ethylbenzene, xylenes, MTBE, 1,2-DCA, and lead. The remaining drinking water PRC are based on tap water RSLs (U.S. EPA, 2009) because MCLs are not available for these COPCs.

(d) Marine ecological receptor PRC are based on the Screening Quick Reference Tables (SQuiRT) (Buchman, 2008). Values are based on chronic benchmarks when available. If a chronic benchmark was not available, an acute value was selected as the PRC.

(e) A residential soil lead PRC of 319 mg/kg was derived using LeadSpread 7 (Cal/EPA, 2000) in Attachment 2 and includes the homegrown produce exposure pathway and incorporates site-specific characteristics of Alameda Point. However, the regulatory agencies have expressed some concern regarding potential inconsistencies that could be created with residential soil remedial goals for lead that have been applied on CERCLA remedial actions at Alameda Point. At the time of the

Table 3. Soil and Groundwater Preliminary Remediation Criteria (continued)

printing of this tech memo the California DTSC suggests the use of a residential soil lead PRC of 150 mg/kg, but also indicates that they are conducting additional evaluations. The Navy has decided to leave the residential soil lead PRC as "TBD" until additional information is available from DTSC's review, and a consensus can be reached with the regulatory agencies.

(f) Because a RSL is not available for acenaphthylene, the RSL for acenaphthene is used as a surrogate.
(g) Because a RSL is not available for benzo(g,h,i)perylene, the RSL for pyrene is used as a surrogate.
(h) Because a Marine Ecological PRC does not exist for 1-methylnaphthalene, naphthalene is used as a surrogate.
(i) TPH soil PRCs have been updated based on the calculations described in Attachment 3.
(j) TTPH Marine Ecological Receptors PRC originate from the *Draft Corrective Action Plan, Sites 04/19, 04, 14/22, 15, 16, 20, and 25, Naval Station Treasure Island, San Francisco, CA* (TtEMI, 1997) and was used in the 2001 Petroleum Strategy.
(k) These PRCs are less than the comparable ESLs from Water Board, 2008 based on different exposure assumptions and have been incorporated into the ESL screening criteria listed in Table 2. For instance the ESLs in Table 2 consider adult-only consumption for tapwater, whereas the U.S. EPA RSL incorporates exposure to an adult and child (i.e., weighted adjustment of exposure factors).
(l) PRCs set at the values recommended in DTSC HHRA Note No. 3 dated May 6, 2009 instead of U.S. EPA RSLs issued in April 2009.

Table 4. Preliminary Remediation Criteria for Protection of Marine Ecological Receptors in Groundwater Discharging to Surface Water Based on Distance to Shoreline[a]

Distance (feet)[b]	Benzene (mg/L)	MTBE (mg/L)	Lead (mg/L)	Total TPH (mg/L)[c]
0	0.110	5.000	0.008	1.400
25	0.115	5.238	0.008	1.467
50	0.164	7.471	0.012	2.092
75	0.253	11.486	0.019	3.216
100	0.380	17.283	0.028	4.839
125	0.546	24.819	0.040	6.949
150	0.749	34.068	0.055	9.539
175	0.990	45.016	0.073	12.604
200	1.268	57.659	0.093	16.145
225	1.584	71.995	0.117	20.000[d]
250	1.936	88.021	0.143	20.000

(a) Based on fate and transport modeling conducted by Tetra Tech EM Inc. for Area 37 Alameda Point (TtEMI, 1997).
(b) Distance measured from shoreline. Concentration at 0 feet indicates shoreline-protection limit.
(c) Based on fate and transport modeling conducted by Parsons Engineering Science, Inc., for Area 37 Alameda Point (Parsons, 2000).
(d) Designated solubility limit for Total TPH.

ATTACHMENT 1

Original Petroleum Strategy

PRELIMINARY REMEDIATION CRITERIA AND CLOSURE STRATEGY FOR PETROLEUM-CONTAMINATED SITES AT ALAMEDA POINT, ALAMEDA, CALIFORNIA

This memorandum presents the preliminary remediation criteria (PRC) and the total petroleum hydrocarbon (TPH) strategy for corrective action areas (CAA) and other potential petroleum-impacted areas at Alameda Point, Alameda, California. The TPH strategy has been revised based on Regional Water Quality Control Board (RWQCB) comments (RWQCB 2001) and agreements reached in meetings held at Alameda Point on January 30, 2001 (Tetra Tech EM Inc. [TtEMI] 2001a) and April 18, 2001 (TtEMI 2001b). The RWQCB comments on the original TPH strategy are included in Attachment A.

To meet RWQCB criteria for low-risk fuel site closure in the San Francisco Bay Region (RWQCB 1996), PRCs and TPH strategies have been developed for soil and groundwater at Alameda Point. The PRCs are listed in Tables 1through 4 and the TPH strategies are shown in Figures 1 through 5. Soil and groundwater PRCs are screening levels that have been determined to be protective of human health or marine ecological receptors. A basewide and a CAA TPH strategy were developed for soil and groundwater. The basewide strategies were developed for potential petroleum-impacted areas currently not included in either the TPH Program or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Program, and for future sites if evidence of contamination is identified during redevelopment. The CAA TPH strategies were developed for sites already included in the TPH Program. The TPH strategies in this memorandum for soil and groundwater begin with an initial evaluation of each site to determine whether floating product is present. If present, floating product will be removed and a decision made on whether the site should be transferred to the CERCLA Program. If the site is not transferred, TPH-related constituents are screened against the PRCs developed for Alameda Point. PRCs are selected for each site based on proposed land reuse (Alameda Redevelopment and Reuse Authority 1996), groundwater designation (TtEMI 2000), and potentially completed exposure pathways. If TPH-related constituents exceed PRCs, risk management considerations are used to determine if a corrective action is warranted. If a corrective action is warranted, remedial alternatives will be developed in a corrective action plan (CAP).

The development of PRCs and a detailed discussion of the TPH strategy are presented below. References cited in this memorandum are listed following the TPH strategy discussion.

PRELIMINARY REMEDIATION CRITERIA

Soil and groundwater PRCs are screening concentrations that have been determined to be protective of human health or of marine ecological receptors. Soil PRCs were developed for TPH-associated compounds (benzene, toluene, ethylbenzene, xylenes, methyl tertiary butyl ether, and lead) and TPH fractions (TPH gasoline-, diesel-, jet fuel-, and motor oil-range). Groundwater PRCs were developed for TPH-associated compounds and total total petroleum hydrocarbons (TTPH). TTPH is defined as the sum of all TPH fractions. PRCs are selected for each site based on proposed land reuse (Alameda Redevelopment and Reuse Authority 1996), groundwater designation (TtEMI 2000), and potentially completed exposure pathways.

Free Product

Screening criteria for floating product were developed. Removal of floating product is a high priority throughout Alameda Point, because it is considered to be a continuing source of groundwater contamination and may pose a potential explosion hazard if encountered during excavation or during transport through storm drains. For soil, the saturation concentration (14,000 milligrams per kilogram [mg/kg]) was selected as the TTPH screening level for floating product. The selection of 14,000 mg/kg as the saturation limit for TTPH in soil is considered to be conservative, based on industry-accepted saturation limits (Cohen and Mercer 1993). For groundwater, the groundwater solubility limit (20 milligrams per liter [mg/L]) was chosen as the TTPH screening level for floating product. The selection of 20 mg/L as the groundwater solubility limit for TTPH was based on chemical data used in the San Francisco Airport study (RWQCB 1999) as presented in the Fuel Hydrocarbon Transport Modeling Report (Parsons 2000). In comparison, naphthalene, a single petroleum hydrocarbon compound used as a surrogate compound to represent TPH by Johnson and Ettinger, has a solubility of 31 mg/L (TPH Criteria Working Group Series 1997). All sites will be assessed for floating product regardless of the proposed land reuse and groundwater designation.

Soil and groundwater PRCs, based on proposed land reuse and groundwater designation, respectively, are summarized below.

Soil Preliminary Remediation Criteria

In addition to the floating product screening level for TTPH of 14,000 mg/kg in soil, two sets of PRCs have been developed based on potential land reuse. PRCs were developed for sites where residential or mixed-reuse (which includes residential reuse) is planned and for sites where no residential or mixed-reuse is planned. The soil PRCs for residential and nonresidential reuse are discussed below and summarized in Table 1.

<u>Residential Reuse (Table 1)</u>

- <u>TPH-associated Compounds</u>. Residential California Environmental Protection Agency (Cal/EPA) preliminary remediation goals (PRGs) were selected as TPH-associated compound PRCs, with the exception of lead. A residential lead PRC was developed using the Department of Toxic Substance Control (DTSC) LeadSpread 7 model. The LeadSpread 7 model was used to estimate blood lead concentrations resulting from exposure to lead through dietary intake, drinking water, soil and dust ingestion, inhalation, and dermal contact. Each of these pathways is represented by an equation relating incremental blood lead increase to a concentration in an environmental medium, using contact rates and empirically determined ratios. The contributions through the five pathways are added to arrive at an estimate of median blood lead concentration resulting from the multi-pathway exposure. 90^{th}, 95^{th}, 98^{th}, and 99^{th} percentile concentrations are estimated from the median assuming a log normal distribution with a geometric standard deviation of 1.6. All exposure parameters and equations are contained within the model and cannot be changed by the user. The only parameters that can be input to this model are the soil lead concentration, water lead concentration, air lead concentration, percent of diet attributable to homegrown produce, and the amount of respirable dust in the air. For the purposes of this evaluation, default DTSC variables were used for all input parameters, with the exception of the water lead concentration. The East Bay Municipal Utility District (EBMUD) treated water lead concentration was used as the water lead concentration. EBMUD is the provider of drinking water for Alameda Point. Lead in effluent water was sampled at six locations at the EBMUD

Treatment Plant. The effluent water was analyzed using EPA Method 200.9, using stabilized temperature graphite furnace atomic absorption spectrometry. The results were reported to a method detection limit (MDL) of 0.15 micrograms per liter (µg/L). All lead results were reported as nondetect at the MDL; therefore, 0.15 µg/L was used as the input parameter for the water lead concentration in the model. The 99^{th} percentile concentration for the child exposure was chosen as the residential lead PRC because children are most sensitive to the affects of lead.

- TPH Fractions. Residential action levels, developed for the Presidio of San Francisco, California (Montgomery Watson 1996), were adopted as TPH fraction PRCs for Alameda Point. Residential action levels developed for the Presidio can be applied at Alameda Point, because exposure parameters and pathways assessed in the Presidio report are the same as, and in some cases more conservative than, those used in the Alameda Point Human Health Risk Assessments (the Presidio calculations are more conservative in the treatment of dermal exposure, because parameters have changed since 1995). Additionally, the action levels were based on a hazard index (HI) of 0.1, which is less than the target HI of 1.0, typically used to make risk management decisions at Alameda Point.

Nonresidential Reuse (Table 1)

- TPH-associated Compounds. Industrial Cal/EPA PRGs were selected as TPH-associated compound PRCs, with the exception of lead. A nonresidential lead PRC was developed using the DTSC LeadSpread 7 model and the same input parameters used to calculate the residential lead PRC. The 99^{th} percentile concentration for the occupational exposure was chosen as the nonresidential lead PRC.

- TPH Fractions. Park maintenance worker/groundskeeper action levels developed for the Presidio (Montgomery Watson 1996) were adopted as TPH fraction PRCs for Alameda Point. Park maintenance worker/groundskeeper action levels developed for the Presidio can be applied at Alameda Point, because the exposure parameters and equations used to assess these exposures are consistent with those used for the construction worker at Alameda Point. This scenario considers a greater exposure to soil than typical occupational exposures, resulting in a conservative action level for soil. Additionally, the action levels were based on a HI of 0.1, which is less than the target HI of 1.0, typically used to make risk management decisions at Alameda Point.

Groundwater Preliminary Remediation Criteria

In addition to the floating product screening level for TTPH of 20 mg/L in groundwater, four sets of PRCs were developed based on potential land reuse, groundwater designation, and potentially completed exposure pathways. PRCs were developed for (1) volatilization of constituents from groundwater to indoor air, (2) groundwater designated as a potential drinking water source, (3) potential exposures to marine ecological receptors through the storm drain exposure pathway, and (4) potential exposures to marine ecological receptors through groundwater discharging to surface water. PRCs for volatilization of constituents from groundwater to indoor air have been developed for sites where residential or mixed-reuse (which includes residential reuse) is planned and for sites where no residential or mixed-reuse is planned. Residential and nonresidential PRCs for volatilization of constituents from groundwater to indoor air are summarized in Table 2. PRCs for groundwater designated as a potential drinking water source and potential exposures to marine ecological receptors through the storm drain exposure pathway are summarized in Table 3. PRCs for potential exposures to marine ecological receptors through groundwater discharging to surface water are presented as a function of distance from the shoreline in Table 4. Groundwater PRCs are discussed below for each of the four categories.

Volatilization of Constituents From Groundwater to Indoor Air (Table 2)

- TTPH. A TTPH PRC was not developed for volatilization of constituents from groundwater to indoor air, because of the widely varying volatilities and concentrations of toxic constituents in different petroleum fuels.

- TPH-associated Compounds. PRCs for volatilization of constituents from groundwater to indoor air were developed for residential and nonresidential reuse for TPH-associated compounds, with the exception of lead. The Johnson and Ettinger model was used to determine groundwater concentrations that would prevent unacceptable risks from inhalation of vapors in indoor air. Lead was not evaluated, because tetraethyl lead, which is a volatile form of lead and was commonly used as a fuel additive, has not been measured specifically in groundwater at Alameda Point. Additionally, the Johnson and Ettinger model does not include the compound tetraethyl lead and it is not possible to add or change chemical information in the model. The Johnson and Ettinger model was run for both residential (continuous exposure for 350 days per year for 30 years) and occupational (continuous exposure for 250 days per year for 25 years) exposure scenarios, using a soil type of sandy loam and the following assumptions and California-specific default values for soil parameters, as presented in the U.S. Environmental Protection Agency (EPA) Region 9 PRGs:

- Groundwater depth:	7 feet
- Depth below grade to bottom of enclosed floor space:	15 centimeters
- Groundwater temperature:	15°C
- Fraction of organic carbon:	0.006
- Water filled soil porosity:	0.25
- Soil porosity:	0.43
- Dry soil bulk density:	1.5 kilograms per liter (kg/L)

Groundwater Designated as a Potential Drinking Water Source (Table 3)

- TTPH. A TTPH PRC was not developed for groundwater considered to be a potential drinking water source, since the toxicity is accounted for with the TPH-associated compounds.

- TPH-associated Compounds. Maximum contaminant levels (MCLs) were selected as TPH-associated compound PRCs for groundwater considered to be a potential drinking water source.

Potential Exposures to Marine Ecological Receptors through the Storm Drain Exposure Pathway (Table 3)

- TTPH. Storm drains could act as conduits for groundwater contaminants to impact aquatic receptors in surface water; therefore, the ecological shoreline-protection limit of 1.4 mg/L was chosen as the TTPH PRC. The ecological shoreline-protection limit was developed during an ecotoxicity study performed at Naval Station Treasure Island (TI) for its petroleum Corrective Action Program (TtEMI 1997). The TI study involved bioassay testing of ecological receptors in the San Francisco Bay to generate a TTPH cleanup level for groundwater that could be applied at the shoreline to protect ecological receptors in the Bay. The ecological shoreline-protection limit of 1.4 mg/L can be applied to Alameda Point, because Alameda Point is in close proximity of Treasure Island within San Francisco Bay, and has very similar aquatic ecological receptors. Dilution and attenuation is not considered to occur in the storm drain migration pathway.

- TPH-associated Compounds. Ambient water quality criteria (AWQC), based on marine criteria continuous concentration (CCC) (National Oceanic and Atmospheric Administration 1999), were selected as PRCs for benzene, toluene, ethylbenzene, and lead. If an AWQC based on a CCC was not available, then an AWQC based on criteria maximum concentration was used. Marine AWQCs do not exist for xylenes or MTBE. An interim MTBE water quality objective developed by RWQCB (RWQCB 1998) was selected as the PRC. The interim MTBE water quality objective was developed based on six literature studies that evaluated acute toxicity to marine organisms. Based on these six studies, a final acute value (FAV) was calculated as the concentration of MTBE corresponding to a cumulative probability effect of 0.5 (concentration that will protect 95 percent of the tested species). A final chronic value (FCV) was developed by dividing the FAV by an acute to chronic ratio of 3.47. The FCV of 8.0 mg/L was chosen as the PRC for MTBE. The AWQCs for toluene and ethylbenzene listed in Table 3 are not consistent with the corresponding levels in petroleum products, specifically gasoline. In essence, the limit of 1.4 mg/L for TTPH would be exceeded before the AWQCs for toluene or ethylbenzene. An AWQC for xylenes has not been developed.

Potential Exposures to Marine Ecological Receptors through Groundwater Discharging to Surface Water (Table 4)

- TTPH. The ecological shoreline-protection limit of 1.4 mg/L was chosen as the TTPH PRC at the shoreline. For distances upgradient of the shoreline, Parsons Engineering Science, Inc. (Parsons), developed two sets of TTPH ecological preliminary remediation goals (EPRG) for Alameda Point (Parsons 2000). TTPH EPRGs were developed for Installation Restoration (IR) Site 7 and for Area 37 for multiple distances upgradient of the shoreline using risk-based corrective action (RBCA) methodologies and transport equations. The ecological shoreline-protection limit of 1.4 mg/L and site-specific input parameters for IR Site 7 and Area 37 were used in the fate and transport modeling. Based on negotiations with RWQCB, TTPH EPRGs developed for Area 37 were chosen as TTPH PRCs for all sites within 250 feet of the shoreline, because Area 37 site characteristics are more representative of shoreline sites than the site characteristics of IR Site 7. At distances greater than 250 feet from the shoreline, fate and transport modeling indicates that TTPH concentrations equal to the solubility limit attenuate to less than 1.4 mg/L at the shoreline.

- TPH-associated Compounds. Per agreements reached with RWQCB in the meeting held at Alameda Point on April 18, 2001 (TtEMI 2001b), PRCs for benzene, MTBE, and lead were developed because benzene and MTBE are highly mobile and lead does not intrinsically biodegrade. AWQCs for benzene and lead and the interim RWQCB water quality objective of 8.0 mg/L for MTBE were chosen as shoreline protection limits. For distances upgradient of the shoreline, PRCs were developed using RBCA methodologies and transport equations presented in the fate and transport modeling report (Parsons 2000). The shoreline protection limits for benzene, lead, and MTBE and the same site-specific model input parameters used in the determination of the TTPH EPRGs for Area 37 were used in the fate and transport modeling. At distances greater than 250 feet from the shoreline, benzene and MTBE concentrations equal to the dissolution limits (57 and 206 mg/L, respectively) will not attenuate to the shoreline protection limits; however, concentrations of benzene less than 12 mg/L and concentrations of MTBE less than 141 mg/L will attenuate to the shoreline protection limits. Concentrations of benzene greater than 12 mg/L and concentrations of MTBE greater than 141 mg/L have not been detected at Alameda Point. Concentrations of lead less than 0.143 mg/L will attenuate to the shoreline protection limit. Isolated sampling locations have concentrations of lead greater than 0.143 mg/L. These isolated sampling locations will be evaluated separately.

Marine screening levels have not been developed for toluene, ethylbenzene, or xylenes. The AWQCs for toluene and ethylbenzene are not consistent with the corresponding levels in petroleum products, specifically gasoline. In essence, the limit of 1.4 mg/L for TTPH would be exceeded before the AWQCs for toluene or ethylbenzene.

Application of the soil and groundwater floating product screening levels and PRCs is included in the revised TPH strategy for Alameda Point, which is detailed below.

TOTAL PETROLEUM HYDROCARBON STRATEGY

Basewide and CAA TPH strategies have been developed for soil and groundwater. The basewide TPH strategies have been developed for potential petroleum-impacted areas currently not included in either the TPH Program or the CERCLA Program and for future sites if contamination is found during redevelopment. The CAA TPH strategies apply to areas already in the TPH Program. The basewide and CAA TPH strategies are intended to assess the need for implementation of a corrective action. If a corrective action is warranted, remedial alternatives will be evaluated in a CAP. Soil and groundwater TPH strategies are summarized below.

Soil Strategy

The base wide and CAA soil TPH strategies are presented in Figures 1 and 2, respectively, and are detailed below.

Step 1 Remove Surface Staining. If areas with significant surface staining are found during redevelopment or if surface staining is present at CAAs in unpaved areas, then surface stains will be removed. Common surface stains from sources, such as dripping oil pans or motor vehicle parking, are not considered significant, and will not be removed. During surface stain removal, if evidence of subsurface contamination is found in areas not located within CAA boundaries, then a subsurface investigation will be conducted.

Step 2 Remove Floating Product. If TTPH concentrations in soil at any depth exceed the floating product screening level of 14,000 mg/kg (the saturation concentration), then a floating product investigation will be conducted, unless deeper soil samples indicate that only surface contamination exists. If floating product is found, an immediate active corrective action will be implemented.

Step 3 Screen Data for CERCLA Contaminants. If CERCLA contaminants are present at concentrations that may present a risk to human health or the environment, TPH contamination (with the exception of floating product) will be handled under the CERCLA Program. This step is included to avoid overlap between the TPH Program and the CERCLA Program.

Step 4 Screen Data. Soil PRCs are selected for each site based on proposed land reuse (Alameda Redevelopment and Reuse Authority 1996). Concentrations of TPH-associated compounds and TPH fractions in soil 0 to 4 feet below ground surface (bgs) are screened against PRCs developed for residential and nonresidential reuse (see Table 1). A screening interval of 0 to 4 feet bgs was chosen, because the shallow depth to groundwater would limit soil contact at deeper depths. Contact with shallow soils is more likely on a daily basis than contact with deeper soil intervals.

Step 5 Conduct Additional Investigation. If sufficient data do not exist to characterize the site, then an additional investigation will be conducted. This step is not included in the CAA TPH strategy, because it is assumed that the CAAs are fully characterized.

Step 6 Determine Need for Corrective Action. Risk management considerations are used to determine if a corrective action is warranted. For example, if numerous samples were collected at a site and only a few of those samples had concentrations that exceed the PRCs and concentrations barely exceed the PRC, then a corrective action may not be warranted. If risk management considerations favor a corrective action, then remedial action alternatives will be evaluated in a CAP.

Groundwater Strategy

The basewide and CAA groundwater TPH strategies are presented in Figures 3 and 4, respectively, and are detailed below. Figure 5 shows the strategy for storm drain investigations, as an element of both the basewide and CAA groundwater TPH strategies.

Step 1 Remove Floating Product. If TTPH concentrations in groundwater exceed the floating product screening level of 20 mg/L (the solubility limit), then a floating product investigation will be conducted. If floating product is found, an immediate active corrective action will be implemented.

Step 2 Screen Data for CERCLA Contaminants. If CERCLA contaminants are present at concentrations that may present a risk to human health or the environment, TPH contamination (with the exception of floating product) will be handled under the CERCLA Program. This step is included to avoid overlap between the TPH Program and the CERCLA Program.

Step 3 Conduct Storm Drain Investigation. If TPH-associated compounds or TTPH concentrations in groundwater near storm drains exceed AWQCs (see Table 3) or 1.4 mg/L respectively, then a storm drain investigation will be conducted. The steps for this investigation are shown in Figure 5. If contaminated groundwater infiltrates the storm drain, then remedial action alternatives will be evaluated in a CAP. Remedial action alternatives will be evaluated for treating groundwater located near the storm drain reach and will not include storm drain repairs (unless used as a temporary measure to keep contaminated groundwater from infiltrating the storm drain system until the selected remedial action for groundwater is complete).

Step 4 Screen Data. Groundwater PRCs are selected for each site based on proposed land reuse (Alameda Redevelopment and Reuse Authority 1996) groundwater designation (TtEMI 2000), and potentially completed exposure pathways. The risk associated with each exposure scenario (ingestion, inhalation of vapors in indoor air, etc.) needs to be assessed; therefore, TTPH and TPH-associated compounds are screened against all applicable PRCs (not just the most stringent PRC). If groundwater is located in an area designated as a potential drinking water source, then TPH-associated compound concentrations are screened against MCLs (see Table 3) and PRCs developed for volatilization of constituents from groundwater to indoor air (see Tables 2). If groundwater is located within 250 feet of the shoreline, then TPH-associated compounds and TTPH concentrations are screened against PRCs developed for multiple distances upgradient of the shoreline (see Table 4) and PRCs developed for volatilization of constituents from groundwater to indoor air. If groundwater is located in an area designated as a potential drinking water source and within 250 feet of the shoreline, then TPH-associated compounds and TTPH concentrations are screened against MCLs, PRCs developed for multiple distances upgradient of the shoreline, and PRCs developed for volatilization of constituents from groundwater to indoor air. If groundwater is not located in an area designated as a potential drinking water source and is not located within 250 of the shoreline, then TPH-associated compounds will only be screened against PRCs developed for volatilization of constituents from groundwater to indoor air.

Step 5 Conduct Additional Investigation. If sufficient data do not exist to characterize the site, then a groundwater investigation will be conducted. This step is not included in the CAA TPH strategy, because it is assumed that the CAAs are fully characterized.

Step 6 Determine Need for Corrective Action. Risk management considerations are used to determine if a corrective action is warranted. If a corrective action is warranted for volatilization of constituents to indoor air, then remedial action technologies will be evaluated in a CAP. If a corrective action is warranted for groundwater designated as a potential drinking water source or groundwater located within 250 feet of the shoreline, then a plume stability analysis will be conducted to evaluate whether the plume is stable or shrinking. The plume stability analysis will be performed using the methodologies used in the fate and transport modeling conducted by Parsons (Parsons 2000). If the plume appears to be stable and there is no significant risk to human health or aquatic receptors, then monitored natural attenuation will be selected as the corrective action. If the plume does not appear to be stable or shrinking, and a significant risk exists to human health or aquatic receptors, then active remedial action technologies will be evaluated in a CAP.

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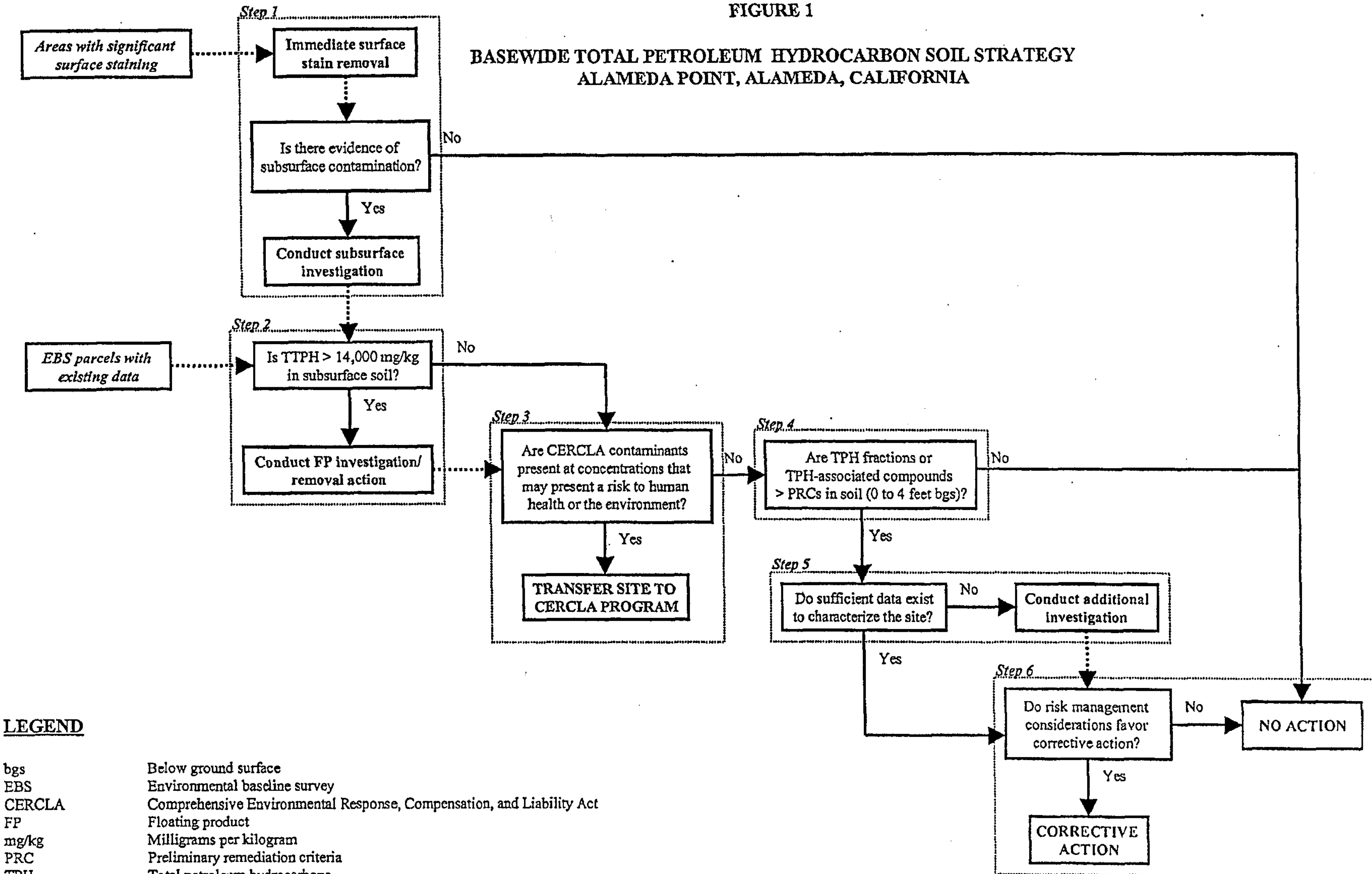
FIGURE 1

BASEWIDE TOTAL PETROLEUM HYDROCARBON SOIL STRATEGY
ALAMEDA POINT, ALAMEDA, CALIFORNIA



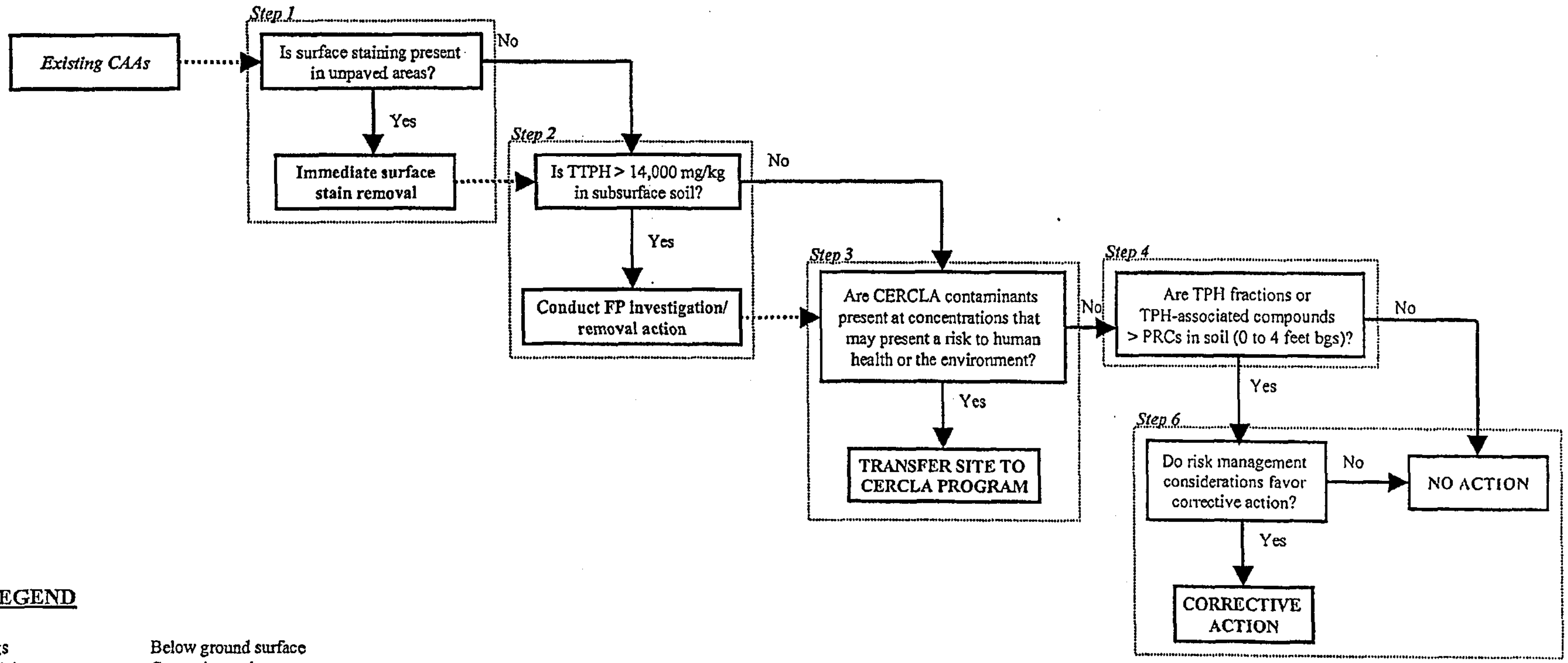
LEGEND

bgs	Below ground surface
EBS	Environmental baseline survey
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
FP	Floating product
mg/kg	Milligrams per kilogram
PRC	Preliminary remediation criteria
TPH	Total petroleum hydrocarbons
TPH-associated compounds	Benzene, toluene, ethylbenzene, xylenes, methyl tertiary butyl ether, and lead
TPH fractions	TPH as gasoline, diesel, jet fuel, and motor oil
TTPH	Total total petroleum hydrocarbons (sum of TPH fractions)

May 16, 2001

FIGURE 2

CORRECTIVE ACTION AREA TOTAL PETROLEUM HYDROCARBON SOIL STRATEGY
ALAMEDA POINT, ALAMEDA, CALIFORNIA



LEGEND

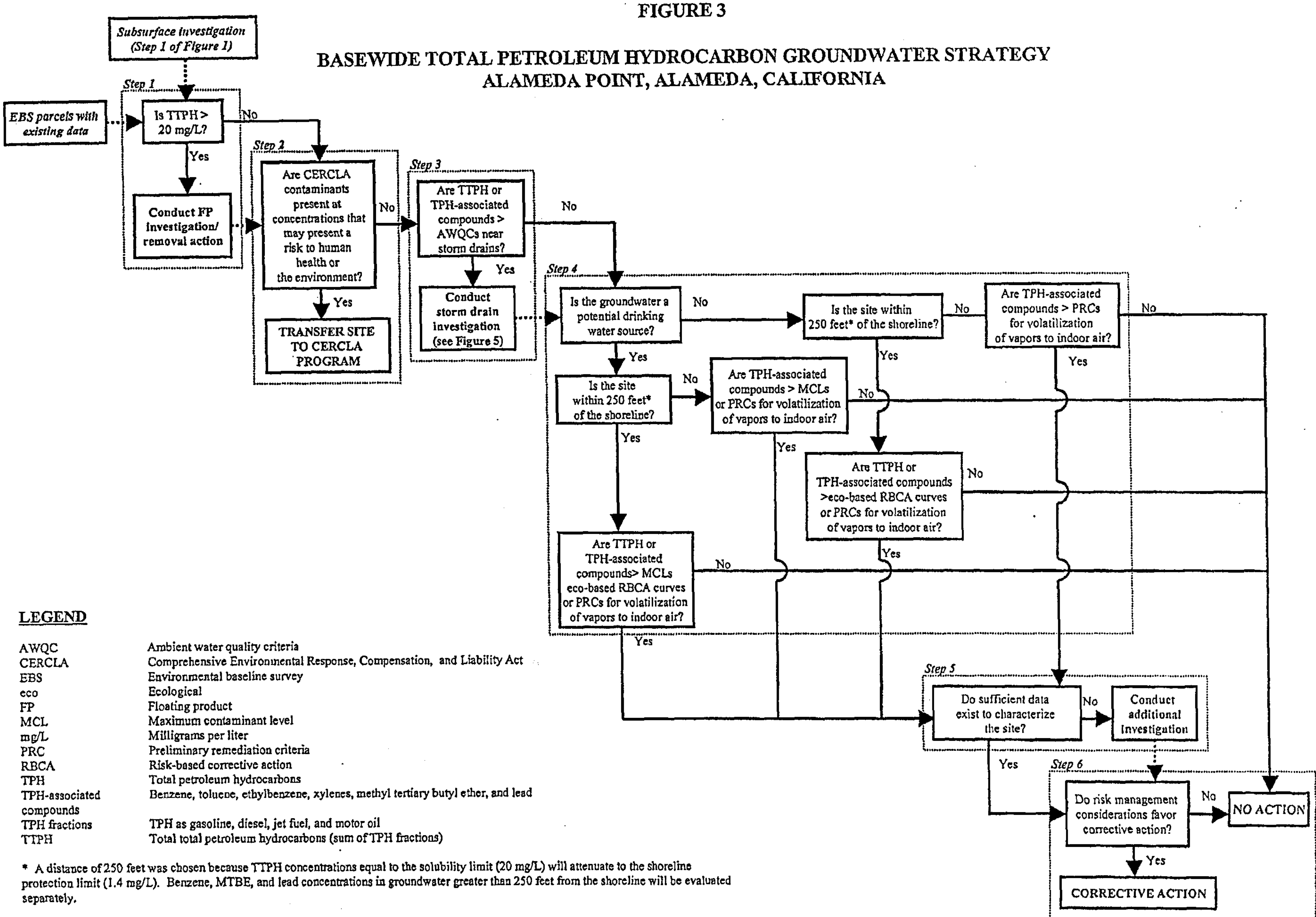
bgs	Below ground surface
CAA	Corrective action area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
FP	Floating product
mg/kg	Milligrams per kilogram
PRC	Preliminary remediation criteria
TPH	Total petroleum hydrocarbons
TPH-associated compounds	Benzene, toluene, ethylbenzene, xylenes, methyl tertiary butyl ether, and lead
TPH fractions	TPH as gasoline, diesel, jet fuel, and motor oil
TTPH	Total total petroleum hydrocarbons (sum of TPH fractions)

Note: Step 5 is not included, because it is assumed that the CAAs are fully characterized.

May 16, 2001

FIGURE 3

BASEWIDE TOTAL PETROLEUM HYDROCARBON GROUNDWATER STRATEGY
ALAMEDA POINT, ALAMEDA, CALIFORNIA



LEGEND

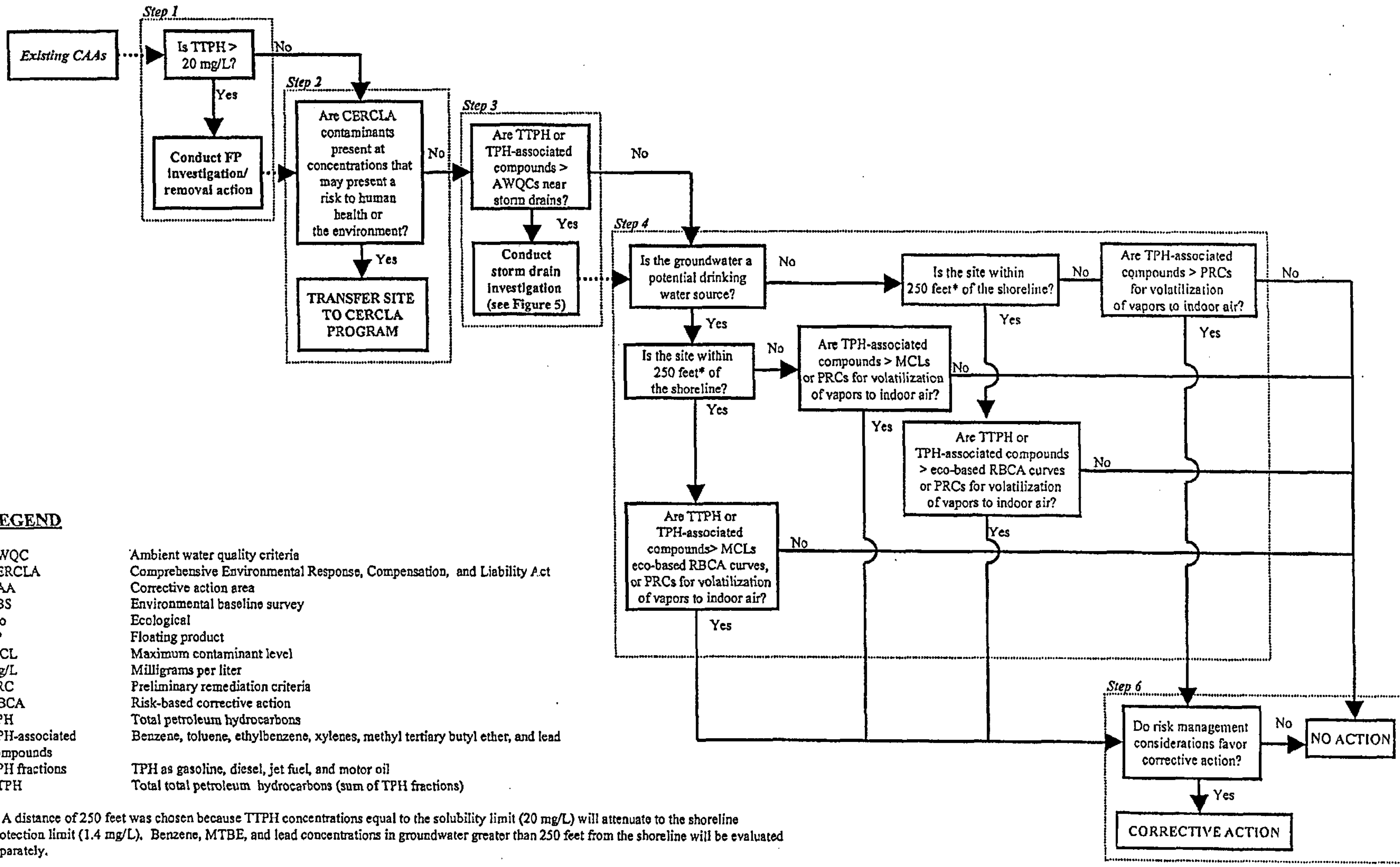
AWQC	Ambient water quality criteria
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
EBS	Environmental baseline survey
eco	Ecological
FP	Floating product
MCL	Maximum contaminant level
mg/L	Milligrams per liter
PRC	Preliminary remediation criteria
RBCA	Risk-based corrective action
TPH	Total petroleum hydrocarbons
TPH-associated compounds	Benzene, toluene, ethylbenzene, xylenes, methyl tertiary butyl ether, and lead
TPH fractions	TPH as gasoline, diesel, jet fuel, and motor oil
TTPH	Total total petroleum hydrocarbons (sum of TPH fractions)

* A distance of 250 feet was chosen because TTPH concentrations equal to the solubility limit (20 mg/L) will attenuate to the shoreline protection limit (1.4 mg/L). Benzene, MTBE, and lead concentrations in groundwater greater than 250 feet from the shoreline will be evaluated separately.

May 16, 2001

FIGURE 4

CORRECTIVE ACTION AREA TOTAL PETROLEUM HYDROCARBONGROUNDWATER STRATEGY
ALAMEDA POINT, ALAMEDA, CALIFORNIA



LEGEND

AWQC	Ambient water quality criteria
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CAA	Corrective action area
EBS	Environmental baseline survey
eco	Ecological
FP	Floating product
MCL	Maximum contaminant level
mg/L	Milligrams per liter
PRC	Preliminary remediation criteria
RBCA	Risk-based corrective action
TPH	Total petroleum hydrocarbons
TPH-associated compounds	Benzene, toluene, ethylbenzene, xylenes, methyl tertiary butyl ether, and lead
TPH fractions	TPH as gasoline, diesel, jet fuel, and motor oil
TTPH	Total total petroleum hydrocarbons (sum of TPH fractions)

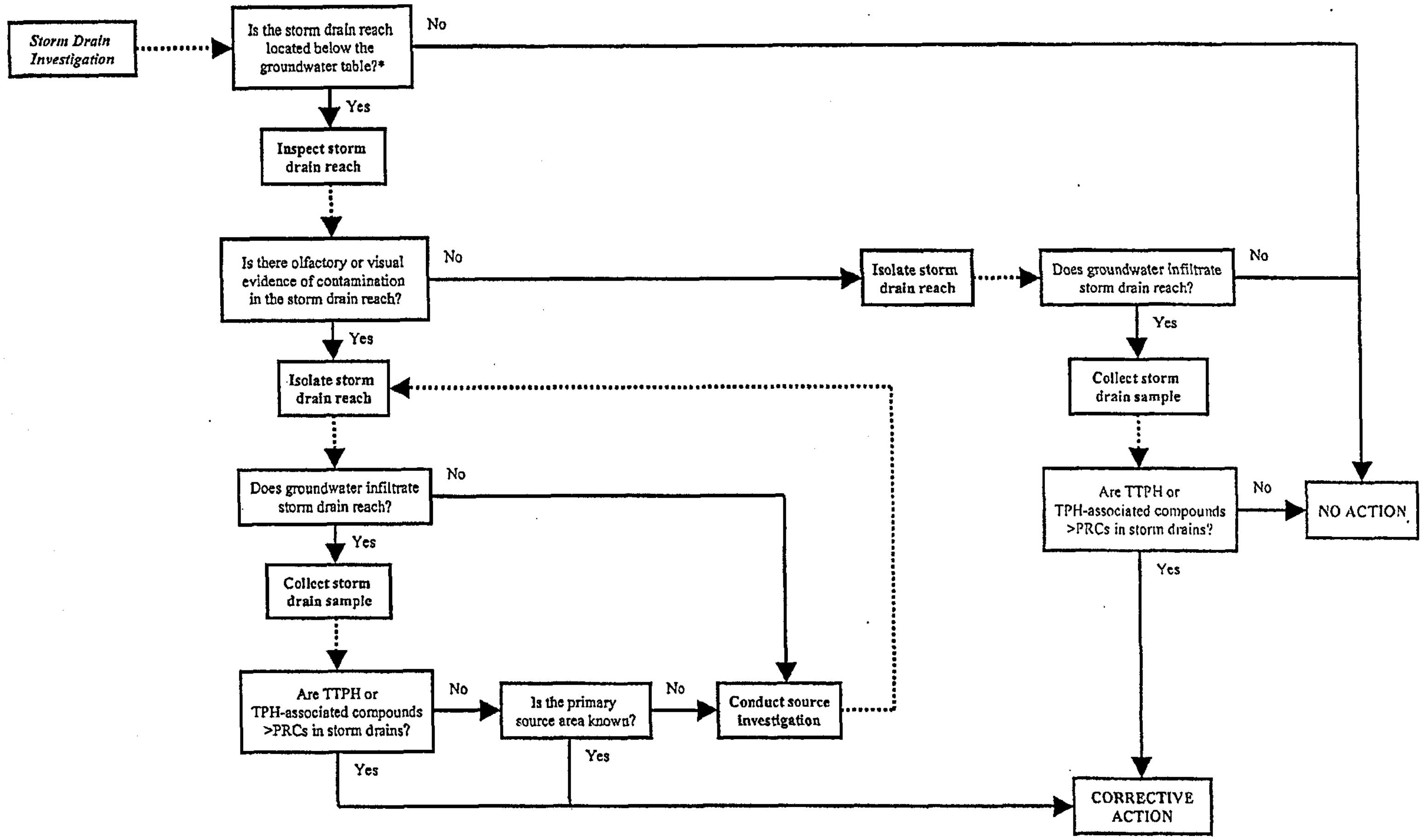
* A distance of 250 feet was chosen because TTPH concentrations equal to the solubility limit (20 mg/L) will attenuate to the shoreline protection limit (1.4 mg/L). Benzene, MTBE, and lead concentrations in groundwater greater than 250 feet from the shoreline will be evaluated separately.

Note: Step 5 is not included, because it is assumed that the CAAs are fully characterized.

May 16, 2001

FIGURE 5

STORM DRAIN INVESTIGATION (STEP 3)
ALAMEDA POINT, ALAMEDA, CALIFORNIA



LEGEND

PRC	Preliminary remediation criteria
TPH	Total petroleum hydrocarbons
TPH-associated compounds	Benzene, toluene, ethylbenzene, xylenes, methyl tertiary butyl ether, and lead
TPH fractions	TPH as gasoline, diesel, jet fuel, and motor oil
TTPH	Total total petroleum hydrocarbons (sum of TPH fractions)

* Groundwater monitoring well data for March and April is used to calculate the groundwater table elevation because the groundwater table is typically at its highest elevation during this period.

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TABLE 1

PRELIMINARY REMEDIATION CRITERIA FOR SOIL ALAMEDA POINT, ALAMEDA, CALIFORNIA

Constituent	Residential (mg/kg)	Nonresidential (mg/kg)
Total Petroleum Hydrocarbon-Associated Compounds		
Benzene	0.65[a]	1.5[d]
Toluene	520[a]	520[d]
Ethylbenzene	230[a]	230[d]
Xylenes (Total)	210[a]	210[d]
Methyl Tertiary Butyl Ether	17[a]	37[d]
Lead	221[b]	4,766[e]
Total Petroleum Hydrocarbon Fractions		
Gasoline	1,030[c]	5,900[f]
Diesel/Jet Fuel	1,380[c]	6,700[f]
Motor Oil	1,900[c]	9,400[f]

Notes:

a Residential Cal-EPA PRG
b DTSC LeadSpread 7 ninety-ninth percentile concentration for the child exposure
c Residential soil action level developed for the Presidio, California
d Industrial Cal-EPA PRG
e DTSC LeadSpread 7 ninety-ninth percentile concentration for the occupational exposure
f Park maintenance worker/groundskeeper soil action level developed for the Presidio, California

Cal-EPA California Environmental Protection Agency
DTSC Department of Toxic Substance Control
mg/kg Milligrams per kilogram
PRG Preliminary remediation goal

Input parameter for LeadSpread 7: water purveyor (East Bay Municipal Utility District) 2000 and 2001 treated effluent data used for drinking water concentration

TABLE 2

PRELIMINARY REMEDIATION CRITERIA FOR VOLATILIZATION OF VAPORS FROM GROUNDWATER TO INDOOR AIR ALAMEDA POINT, ALAMEDA, CALIFORNIA

(Page 1 of 1)

Constituent	Residential[a] (mg/L)	Nonresidential[b] (mg/L)
Total Petroleum Hydrocarbon-Associated Compounds		
Benzene	0.00991	0.0167
Toluene	33.2	46.5
Ethylbenzene	169	169
Xylenes (Total)	106	148
Methyl Tertiary Butyl Ether	8.1	13.6
Lead	No Value	No Value
Total Total Petroleum Hydrocarbons	No Value	No Value

Notes:

a Based on a continuous exposure of 350 days per year for 30 years, Johnson and Ettinger model

b Based on a continuous exposure of 250 days per year for 20 years, Johnson and Ettinger model

mg/L Milligrams per liter

Input parameters used for Johnson and Ettinger model:

- Soil type = sandy loam
- Water filled soil porosity = 0.25
- Soil porosity = 0.43
- Groundwater depth = 7 feet
- Depth below grade to bottom of enclosed floor space = 15 centimeters

TABLE 3

PRELIMINARY REMEDIATION CRITERIA FOR GROUNDWATER CONSIDERED A POTENTIAL DRINKING WATER SOURCE AND POTENTIAL EXPOSURES TO MARINE ECOLOGICAL RECEPTORS THROUGH THE STORM DRAIN EXPOSURE PATHWAY
ALAMEDA POINT, ALAMEDA, CALIFORNIA

Constituent	Potential Drinking Water Source MCL[a] (mg/L)	Marine Ecological Receptors Storm Drain Exposure Pathway Ambient Water Quality Criteria[c] (mg/L)
Total Petroleum Hydrocarbon-Associated Compounds		
Benzene	0.001	0.7
Toluene	0.15	5
Ethylbenzene	0.7	0.43
Xylenes (Total)	1.75	No Value
Methyl Tertiary Butyl Ether	0.005[b]	8.0[d]
Lead	0.015	0.0081
Total Total Petroleum Hydrocarbons	No Value	1.4[e]

Notes:

a California primary MCL, unless noted otherwise
b California secondary MCL
c National Oceanic and Atmospheric Administration Screening Quick Reference Tables, 1999. Unless Noted Otherwise.
d Regional Water Quality Control Board, 1998. "Recommended Interim Water Quality Objective (or Aquatic Life Criteria) for Methyl Tertiary-Butyl Ether." September.
e Tetra Tech EM Inc. 1997. "Draft Corrective Action Plan, Sites 04/19, 04, 14/22, 15, 16, 20, and 25, Naval Station Treasure Island, San Francisco, California." September.

MCL California maximum contaminant level
mg/L Milligrams per liter

TABLE 4

PRELIMINARY REMEDIATION CRITERIA FOR MARINE ECOLOGICAL RECEPTORS IN GROUNDWATER DISCHARGING TO SURFACE WATER BASED ON DISTANCE TO SHORELINE
ALAMEDA POINT, ALAMEDA, CALIFORNIA
(Page 1 of 1)

Distance[a] (Feet)	Total Petroleum Hydrocarbon-Associated Compounds[b]			Total TPH[c] (mg/L)
	Benzene (mg/L)	MTBE (mg/L)	Lead (mg/L)	
0	**0.700**	**8.000**	**0.008**	**1.400**
25	0.733	8.380	0.008	1.467
50	1.046	11.953	0.012	2.092
75	1.608	18.377	0.019	3.216
100	2.420	27.653	0.028	4.839
125	3.475	39.711	0.040	6.949
150	4.769	54.508	0.055	9.539
175	6.302	72.025	0.073	12.604
200	8.072	92.255	0.093	16.145
225	10.079	115.192	0.117	20.000 [d]
250	12.323	140.833	0.143	20.000

Notes:

a	Distance measured from shoreline. Concentration at 0 feet indicates shoreline-protection limit.
b	Based on fate and transport modeling conducted by Tetra Tech EM Inc. for Area 37 Alameda Point
c	Based on fate and transport modeling conducted by Parsons Engineering Science, Inc., for Area 37 Alameda Point
d	Designated solubility limit for Total TPH
mg/L	Milligrams per liter
MTBE	Methyl tertiary butyl ether
Total TPH	Total Total Petroleum Hydrocarbons (sum of all TPH Fractions)
TPH Fractions	TPH as gasoline, diesel, jet fuel, and motor oil

ATTACHMENT A

RESPONSE TO REGIONAL WATER QUALITY CONTROL BOARD COMMENTS ON THE TOTAL PETROLEUM HYDROCARBON STRATEGY AT ALAMEDA POINT, ALAMEDA, CALIFORNIA

REGIONAL WATER QUALITY CONTROL BOARD COMMENT	NAVY RESPONSE
Page 2, Paragraph 1: It is important to note that ambient water quality criteria (AWQC) have not been promulgated for total petroleum hydrocarbons (TPH) as a general pollutant class. Rather, the surface water protection goal of 1.4 milligrams per liter (mg/L) was developed as a site-specific value for Treasure Island Naval Station (TI). Based on our best professional judgment and with the Navy's concurrence, we believe that it is appropriate to also apply this TPH goal at Alameda Point. Please revise the document to more accurately reflect the nature of the surface water protection goal for TPH and why it is applicable to Alameda Point. We agree that where they exist AWQC's are the most appropriate surface water protection goals for other petroleum related compounds.	The TPH strategy was revised to state, "the ecological shoreline-protection limit of 1.4 mg/L was chosen as the total total petroleum hydrocarbon (TTPH) preliminary remediation criteria (PRC). The ecological shoreline-protection limit was developed during an ecotoxicity study performed at TI for its petroleum corrective action program. The TI study involved bioassay testing of ecological receptors in the San Francisco Bay to generate a TTPH level for groundwater that could be applied at the shoreline to protect ecological receptors in the Bay. The ecological shoreline-protection limit of 1.4 mg/L can be applied to Alameda Point, because Alameda Point is located within the same bay and has very similar aquatic ecological receptors."
Page 2, Paragraph 3: Please state that Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) contaminants in soil will be addressed similarly to CERCLA contaminants in groundwater as presented in (2) of the Groundwater Cleanup Strategy section.	Step 3 of the TPH soil strategy was revised to state, "If CERCLA contaminants are present in soil at concentrations that may present a risk to human health or the environment, TPH contamination (with the exception of floating product) will be handled under the CERCLA Program."
Page 2, Paragraph 4 (Subsection 1): We believe it is important to identify what actions the Navy will implement as interim measures. Based on our experience, passive product recovery methods are of limited utility, especially in hydrogeologic conditions like those found at Alameda Point. We encourage the Navy to identify active interim or final remedies that can be feasibly used to recover product/non-aqueous phase liquid (NAPL) at the site and implement them as soon as possible.	The Navy presented the technologies they plan on implementing at the site to recover product/NAPL at a meeting held at Alameda Point on January 30, 2001. Brad Job with Regional Quality Control Board (RWQCB) approved the technologies that the Navy plans to implement.
Page 3, Paragraph 1 (Subsection 2): The Navy should identify a step in the process where the City of Alameda's anticipated land use(s) are evaluated prior to determining the appropriate cleanup goals. In addition, we believe that it is appropriate for the Navy to assist the City of Alameda in developing and implementing soil and groundwater management measures and possibly land use controls to ensure the long-term success of the remedy at sites where petroleum contamination will remain in-place.	PRCs were developed based on proposed land reuse. In Step 4 of the revised soil strategy concentrations of TPH-associated compounds (benzene, toluene, ethylbenzene, xylenes [BTEX], methyl tertiary butyl ether [MTBE], and lead) and TPH fractions (TPH gasoline-, diesel-, jet fuel-, and motor oil-range) are screened against PRCs developed for residential and nonresidential reuse. The potential reuse of each site will be determined prior to selecting PRCs. The City of Alameda indicated in a meeting held at Alameda Point on January 30, 2001, that a soil management plan for Alameda Point was being developed. The Navy will review the soil management plan and determine if it

REGIONAL WATER QUALITY CONTROL BOARD COMMENT	NAVY RESPONSE
	can be applied to petroleum-impacted areas at Alameda Point.
While we support the Navy's adoption of the goals developed for the Presidio of San Francisco (Presidio), we believe that it is still appropriate for the Navy to demonstrate that the Presidio goals were derived consistent with the methods that will be used to evaluate carcinogenic risks for non-petroleum CERCLA contaminants at Alameda Point. It is also appropriate to justify why the park maintenance exposure scenario is applicable to Alameda Point. For those petroleum constituents that are carcinogens, we are unwilling to approve the proposed cleanup goals until the Department of Toxic Substances Control (DTSC) makes a finding that the assessment methodologies and acceptable cancer risk endpoints are reasonably consistent for both petroleum and non-petroleum pollutants at Alameda Point. We understand that Mr. Glenn Brown of DTSC's Standardized Permit and Corrective Action Branch has already initiated a review of the Presidio risk assessment documents.	In the January 30, 2001, meeting, Navy, RWQCB, and DTSC concurred that California Environmental Protection Agency (Cal-EPA) preliminary remediation goals (PRG) should be used as PRCs for petroleum constituents that are carcinogens at Alameda Point, instead of action levels developed for the Presidio. Therefore, the Navy will not need to demonstrate that the Presidio goals were derived consistent with the methods that will be used to evaluate carcinogenic risks for petroleum constituents that are carcinogens at Alameda Point. The strategy was revised to reflect the use of Cal-EPA PRGs. Park maintenance worker/groundskeeper action levels developed for the Presidio can be applied at Alameda Point, because the exposure parameters and equations used to assess these exposures are consistent with those used for the construction worker at Alameda Point. This scenario considers a greater exposure to soil than typical occupational exposures, resulting in a conservative action level for soil. This justification has been added to the revised TPH strategy.
<u>Page 3, Paragraph 3 (Subsection 3):</u> Both the California Health and Safety Code and the California Water Code prohibit creation of public nuisance conditions as a result of pollutant releases. Olfactory or visual evidence of soil or groundwater contamination, tar seeps, or petroleum sheens discharging to storm drains or surface water are all interpreted by this agency to constitute public nuisances. The Navy must ensure that all public nuisances resulting from petroleum releases are adequately abated before the RWQCB will concur that corrective actions are complete. The Navy should also assist the City of Alameda in developing soil and groundwater management plans to be implemented by the city, the site developer, and future landowners to ensure that public nuisance or pollution conditions are not created in the future as a result of site grading, excavating, or dewatering activities.	Step 1 of the revised soil strategy states "If areas with significant surface staining are found during redevelopment or if surface staining is present at corrective action areas (CAA) in unpaved areas, then surface stains will be removed." Additionally, if olfactory or visual evidence of contamination is present in a storm drain reach (see Step 3 [Figure 5] of the revised groundwater strategy), then a remedial action alternative will be evaluated in a corrective action plan (CAP). Remedial action alternatives will be evaluated for treating groundwater located near the storm drain reach and will not include storm drain repairs (unless used as a temporary measure to keep contaminated groundwater from infiltrating the storm drain system until the selected remedial action for groundwater is complete). The City of Alameda indicated in the January 30, 2001, meeting that a soil management plan for Alameda was being developed. The Navy will review the soil management plan and determine if it can be applied to petroleum-impacted areas at Alameda Point.

REGIONAL WATER QUALITY CONTROL BOARD COMMENT	NAVY RESPONSE
Page 5, Paragraph 1, (Subsection 5): This section should be revised to read: "If NAPL has been recovered to the extent practicable and the contamination is located in an area not designated as a potential drinking water source and at a distance greater than 250 feet from the shoreline and no impact to storm drains appears likely, then the remediation criteria applied to groundwater will be developed be protective of indoor air exposures for volatile organic chemicals based on the anticipated future land use."	PRCs for volatilization of constituents to indoor air were developed for residential and nonresidential reuse for TPH-associated compounds, with the exception of lead. The Johnson and Ettinger model was used to determine groundwater concentrations that would prevent unacceptable risks (based on an HI of 1.0) from inhalation of vapors in indoor air. The Johnson and Ettinger model was run for both residential (continuous exposure for 350 days per year for 30 years) and occupational (continuous exposure for 250 days per year for 25 years) exposure scenarios, using a soil type of sandy loam and California-specific default values for soil parameters, as presented in the U.S. Environmental Protection Agency (EPA) Region 9 PRGs. Table 2 of the revised TPH strategy lists the residential and nonresidential PRCs for volatilization of vapors to indoor air. All petroleum-impacted sites will be screened against these PRCs. If BTEX concentrations exceed the PRCs and if risk management considerations favor a corrective action, then remedial action alternatives will be evaluated in a CAP.
Page 5, Paragraph 2, (Subsection 6): Similar to the above comment regarding AWQCs and surface water protection goals for petroleum hydrocarbons, if groundwater containing concentrations in excess of these goals is found to be impacting aquatic receptors then a condition of pollution will exist and an engineered corrective action will be necessary. For locations where the evidence regarding surface water impacts is equivocal, a corrective action plan will also be necessary. We note as an aside that monitored natural attenuation should be implemented through a corrective action plan. At this site, for those groundwater plumes where groundwater has been impacted by petroleum but surface water or drinking water beneficial uses are not threatened and human health risks are negligible, we believe that natural recovery can be relied on with little or no additional groundwater monitoring.	If TPH-associated compounds and TTPH concentrations in groundwater exceed PRCs for groundwater designated as a potential drinking water source or groundwater located within 250 feet of the shoreline and risk management considerations indicate the need for corrective action, then a plume stability analysis will be conducted to evaluate whether the plume is stable or shrinking. If the plume stability analysis indicates that the plume is not migrating, then monitored natural attenuation will be evaluated in a CAP. If the plume stability analysis indicates that the plume is not shrinking and is migrating, then active remedial action alternatives will be evaluated in a CAP.
Figure 2, Groundwater TPH Cleanup Strategy: The potential zone for surface water impacts resulting from migration of dissolved pollution is stated as 250 feet in the text and as 500 feet in the flow chart. Please resolve this discrepancy.	The potential zone for surface water impacts resulting from migration of dissolved pollution is stated as 250 feet in the text and figures of the revised strategy.

REGIONAL WATER QUALITY CONTROL BOARD COMMENT	NAVY RESPONSE
Table 2, Preliminary Remediation Criteria for Groundwater: The values in the groundwater discharging to surface water column should be identical to those in the AWQC column. We believe that it is appropriate to identify the source for the TTPH value in the AWQC column in a footnote. We could not identify an MTBE value in the table associated with footnote (c). We are unaware of the existence of an AWQC for xylenes and our review of the AWQC information for ethylbenzene indicates that the AWQC value should read 0.430 mg/l versus 0.043 mg/l as presented in the table.	Per agreements reached with RWQCB in a meeting held at Alameda Point on April 18, 2001, PRCs for potential exposures to marine ecological receptors through groundwater discharging to surface water were developed for benzene, MTBE, and lead, because benzene and MTBE are highly mobile and lead does not intrinsically biodegrade. AWQCs for benzene and lead and the interim RWQCB water quality objective of 8.0 mg/L for MTBE (see below) were chosen as shoreline protection limits. For distances upgradient of the shoreline, PRCs were developed using risk-based corrective action methodologies and transport equations presented in the fate and transport modeling report conducted by Parsons Engineering Sciences, Inc., for Installation Restoration Site 7 and Area 37. AWQCs for benzene and lead and the RWQCB interim water quality objective for MTBE were used in the fate and transport model to back calculate inland concentrations that would attenuate to AWQCs at the shoreline. PRCs for groundwater discharging to surface water are presented in Table 4 of the revised strategy. A footnote was added to the TTPH value presented in the AWQC column in Table 3 of the revised strategy. An interim MTBE water quality objective developed by RWQCB was selected as the PRC. The interim MTBE water quality objective was developed based on six literature studies that evaluated acute toxicity to marine organisms. Based on these six studies, a final acute value (FAV) was calculated as the concentration of MTBE corresponding to a cumulative probability effect of 0.5 (concentration that will protect 95 percent of the tested species). A final chronic value (FCV) was developed by dividing the FAV by an acute to chronic ratio of 3.47. The FCV of 8.0 mg/L was chosen as the PRC for MTBE. The value for xylenes was removed from Table 3 in the revised strategy, because an AWQC does not exist. The AWQC value for ethylbenzene was changed to 0.43 mg/L in Table 3 of the revised strategy.

California Regional Water Quality Control Board
San Francisco Bay Region

Winston H. Hickox
Secretary for Environmental Protection

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Gray Davis
Governor

GREG —

Date: June 11, 2001
File No.: 2199.9285 (LBJ)

Mr. Mike McClelland, BEC
U.S. Navy
EFD Southwest
1220 Pacific Hwy
San Diego, CA 92132-5190

Subject : Preliminary Remediation Criteria and Closure Strategy for Petroleum-Contaminated sites at Alameda Point, Alameda Point, California.

Dear Mr. McClelland:

Regional Water Quality Control Board (RWQCB) staff has reviewed the document titled *Preliminary Remediation Criteria and Closure Strategy for Petroleum-Contaminated sites at Alameda Point, Alameda Point, California* dated May 16, 2001. This consensus document identifies the preliminary remediation criteria (PRCs) to be applied at petroleum release sites at the former Alameda Naval Air Station. We concur with the findings of this document and look forward to implementation of the closure strategy.

In summary, significant quantities of petroleum hydrocarbons were released into the environment as a result of activities at the former Alameda Naval Air Station. The Navy has identified PRCs for petroleum and petroleum-related compounds that are intended to be protective of human health, safety and the environment. The primary goals of the remediation effort are to:

- Remove floating product to the maximum extent practicable
- Remediate vadose zone soils to levels that do not result in unacceptable human health risks, safety concerns, or nuisance conditions
- Prevent petroleum-polluted groundwater from causing adverse effects in San Francisco Bay or indoor air.
- Protect and enhance the beneficial uses of surface water and groundwater at the site.

The cleanup strategy and the PRCs were derived in consultation with several studies including a human health risk assessment performed for the Presidio of San Francisco, aquatic toxicity studies performed for Treasure Island Naval Station, and a natural attenuation study specific to the conditions observed at Alameda Point. We believe that implementation of the resulting cleanup strategy should result in adequate protection of human health, safety, and the environment and have no objection to finalizing the document.

We appreciate the efforts of the individuals involved in this project. Should you have any questions regarding this matter, please contact me at (510)-622-2400.

Sincerely,

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ATTACHMENT 2

Proposed Residential Remediation Criteria for Lead for Petroleum Program at Alameda Point, Alameda, California

Technical Memorandum

Proposed Residential Remediation Criteria for Lead Petroleum Program at Alameda Point Alameda, California

Draft

December 2008

Executive Summary

The Navy conducted an evaluation of petroleum sites in accordance with the Total Petroleum Hydrocarbon (TPH) Strategy (herein referred to as Petroleum Strategy) developed for Alameda Point, which includes comparison of soil lead concentrations to a residential preliminary remediation criterion (PRC) developed in 2001. As part of the lead PRC review, the Navy discovered that screening levels for lead varied across sites designated for potential future residential land use at Alameda Point. Therefore, the Navy conducted a comparison among these different residential lead screening levels including screening levels derived by California Environmental Protection Agency (Cal-EPA) based on Cal-EPA's LeadSpread 7 model and U.S. EPA using U.S. EPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model.[1]

The lead screening values included in the comparison ranged 150 milligrams per kilogram (mg/kg) to 400 mg/kg for a residential setting, depending on exposure assumptions and input parameter values, in addition to which lead model was used to derive the screening value. California-agency screening values (i.e., 150 mg/kg for the Office of Environmental Health Hazard Evaluation [OEHHA] and Department of Toxic Substances Control [DTSC] Pollution Prevention Programs and 255 mg/kg for the DTSC Schools Sites Program) are much lower than the U.S. EPA value of 400 mg/kg. Lead screening values used at Alameda Point were derived using Cal-EPA's LeadSpread 7 model and ranged from 150 mg/kg to 230 mg/kg. The Alameda Point screening levels were more consistent with California-agency values, but varied based on input parameter assumptions for air, water, and homegrown produce. In addition, the use of the 95th and 99th percentile[2] values for the screening value varied with no clear reason for using one versus another.

Although the U.S. EPA lead screening value of 400 mg/kg is derived using a more detailed blood lead model, it does not include the Cal-EPA-recommended exposure pathway for consumption of homegrown produce. Similarly, the DTSC Schools Sites Program lead screening value of 255 mg/kg does not include the homegrown produce exposure pathway either. Alameda Point risk assessments generally include consumption of homegrown produce, therefore, the EPA and DTSC school sites screening values are not considered appropriate for screening purposes at Alameda Point. The OEHHA and DTSC Pollution Prevention Program's screening value of 150 mg/kg was based on Cal-EPA-recommended default input parameters for air, water, percent homegrown produce, and respirable dust. However, this value was not considered to be the most appropriate value for screening at Alameda Point because site specific values

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[1] The IEUBK model was originally released in 1994 as a DOS version, but has since been converted to Windows (IEUBKwin v1.0 build 264). In terms of functionality, the IEUBKwin model is essentially the same as earlier versions of the model (version 0.99d and version 1.0).

[2] A **percentile** is the value of a variable below which a certain percent of observations fall. So the 95th percentile is the value below which 95 percent of the observations may be found and the 99th percentile is the value below which 99 percent of the observations may be found.

for these input parameters were available. Cal-EPA recommends that site-specific data be used as input parameters when such data exist. Therefore, site specific parameters for air, water, and percent homegrown produce were determined and entered into the LeadSpread 7 model.

Based on the review of existing information and evaluation of viable exposure pathways, a residential soil lead screening value of 319 mg/kg is proposed for use at Alameda petroleum sites. This screening level was derived using LeadSpread 7 and includes the homegrown produce exposure pathway and incorporates site-specific characteristics of Alameda Point.

1.0 Introduction

An evaluation of petroleum sites is being conducted by the Navy in accordance with the Petroleum Strategy developed for Alameda Point (i.e., *Preliminary Remediation Criteria and Closure Strategy for Petroleum-Contaminated Sites at Alameda Point* [Navy, 2001]) in conjunction with guidance issued by the Water Board on the closure of low-risk fuel sites in the San Francisco Bay region (Water Board, 1996). The Water Board's guidance on low-risk fuel site closure was issued to address leaking underground storage tank (LUST) cleanups. The low risk guidelines provide general criteria that are used to identify sites where petroleum contamination falls within the "low risk" category and therefore can be passively biodegraded. Soil and groundwater preliminary remediation criteria (PRCs), developed in consultation with the Water Board and Cal-EPA DTSC to meet Water Board criteria for low-risk fuel site closure, and the low-risk criteria are being used to screen the historical data for petroleum sites at Alameda Point.

Since the Petroleum Strategy was developed for Alameda Point over five years ago, the Water Board requested and Navy agreed to review and update PRCs to be consistent with current toxicity and risk assessment methodology. During review of existing PRCs, the Navy identified several different residential values for lead that were used for screening purposes at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites at Alameda Point, none of which match the 2001 Petroleum Strategy lead PRC value of 221 mg/kg. Although all of the lead values used at Alameda Point were derived using Cal-EPA's LeadSpread 7, as was the 2001 lead PRC value, the input parameter values varied, resulting in different screening values across Alameda Point. In addition to the various residential lead values used for screening purposes at Alameda Point, U.S. EPA and Cal-EPA have their own recommended lead screening values that are important to consider. The non-residential lead screening value of 800 mg/kg[3] has been used consistently across applicable sites at Alameda Point; therefore, this particular lead screening value did not require further review and update.

1.1 Purpose

The purpose of this evaluation is to examine and compare existing site-specific residential lead screening values developed for Alameda Point and the default lead screening values recommended by U.S. EPA and Cal-EPA. In addition, a residential soil lead screening value was developed and is proposed for use at Alameda Point petroleum sites. The soil lead screening value could potentially be applied to other regulated sites at Alameda Point (e.g., CERCLA Installation Restoration [IR] sites).

2.0 Residential Lead Screening Criteria for Soil

Estimation of exposure to lead is based on blood lead levels. The residential screening levels for lead are derived based on pharmacokinetic models, using either U.S. EPA's IEUBK Model (U.S. EPA, 2005) or

[3] Consistent with the industrial lead screening level recommended by U.S. EPA in the "Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites" dated September 2008 (http://www.epa.gov/region09/waste/sfund/prg/index.html)

Cal-EPA's LeadSpread 7 model (Cal-EPA, 2000), which are designed to predict the probable blood lead concentrations for children who have been exposed to lead through various sources (air, water, soil, dust, diet and in utero contributions from the mother).

The IEUBK model estimates blood lead concentration in children (0 to 84 months of age) from an absorbed dose of lead via exposure to various environmental media (air, soil, dust, and diet). This model uses standard age-weighted exposure parameters for consumption of food, drinking water, soil, and dust, and inhalation of air, matched with site-specific concentrations of lead in these media, to estimate exposure for the child, and simulates lead uptake, distribution within the body, and elimination of lead from the body (U.S. EPA, 1994a). The IEUBK model also allows a user-specified maternal blood lead concentration, indoor/outdoor ratios for dust, activity, and air, and optional inputs for additional sources of lead, such as paint.

LeadSpread 7 predicts lead concentration in children (age 2 to 3 years old) from an applied lead dose determined from inputs from soil, dust, water, air, and food. Concentrations of lead in blood are based on five exposure pathways: dermal contact with site soil/dust, ingestion of site soil/dust, background air inhalation, dust inhalation from a site, ingestion of drinking water, ingestion of market basket food, and ingestion of homegrown produce (Cal-EPA DTSC, 2004). Like the IEUBK model, LeadSpread 7 uses slope factors[4] to estimate blood concentration.

Results of a comparison between the IEUBK and LeadSpread models conducted by Cal-EPA Human and Ecological Risk Division (Wade, 2005) showed that both models (1) predict central tendency of blood lead, then generate a lognormal distribution using an assumed geometric standard deviation, and (2) allow for site-specific inputs. However, the overarching conclusion that Cal-EPA made regarding the two models is that the IEUBK provides the most detailed modeling available for blood lead in children, whereas LeadSpread 7 provides a first approximation of IEUBK results for the 2 to 3 year old child.

Health effects of concern have been determined to be associated with childhood blood lead concentrations at or below 10 micrograms per deciliter (μg/dL) (U.S. EPA, 1986, 1990; Centers for Disease Control and Prevention [CDC], 1991); thus, both models use this blood lead level as a target value. Tables 1 and 2 provide summaries of the lead screening values examined in this memo along with the input parameters used to derive these values.

2.1 Comparison of Lead Screening Values

As observed in Tables 1 and 2, the lead screening values range from 150 mg/kg up to 400 mg/kg for a residential setting, depending on exposure assumptions and input parameter values, in addition to which lead model was used to derive the screening value. California-agency screening values are much lower than the U.S. EPA value of 400 mg/kg (Table 1). Lead screening values for Alameda Point range in value based on site-specific input parameters but are generally consistent with the California DTSC values (Table 2).

The U.S. EPA value of 400 mg/kg was calculated using the IEUBK model with default parameters, which does not include ingestion of homegrown produce (although the option to include homegrown produce is available within the model). U.S. EPA's OSWER Directive #9355.4-12, *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Action Facilities* (U.S. EPA, 1994b), recommends the 400 mg/kg screening level for lead in soil for residential land use and the U.S. EPA's 1998 OSWER Directive #9200.4-27P, *Clarification to the 1994 Revised Interim Soil Lead (Pb) Guidance for CERCLA Sites and RCRA Corrective Action Facilities* (U.S. EPA, 1998a), established the use of the IEUBK Model as the

[4] A slope factor is the change in blood lead concentration resulting from each μg/day of lead intake.

Table 1. Summary of Agency-Recommended Lead Residential Screening Values

Parameters	Federal or State Agency			
	U.S. EPA[a]	Cal-EPA DTSC School Sites Program[b]	Cal-EPA OEHHA and DTSC Pollution Prevention Programs[c]	Water Board's ESL[d]
Soil Screening Level	400	255	150	150
Default Values				
Lead in Air ($\mu g/m^3$)	0.1	0.028	0.028	0.028
Lead in Water ($\mu g/L$)	4	15	15	15
Respirable dust ($\mu g/m^3$)	0.1	1.5	1.5	1.5
Includes lead in market basket?	Yes	Yes	Yes	Yes
Include homegrown produce?	No	No	Yes	Yes
Percentile value of blood lead equal to 10 $\mu g/dL$ for a child	95^{th}	99^{th}	99^{th}	99^{th}
Lead Model Employed	IEUBK	LeadSpread 7	LeadSpread 7	LeadSpread 7

OEHHA - Office of Environmental Health Hazard Evaluation

(a) USEPA, 1994b. Memorandum: *OSWER Directive: Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities*. EPA OSWER Directive #9355.4-12, August.

(b) Cal-EPA, 2006. *Interim Guidance Evaluation of School Sites with Potential Soil Contamination as a Result of Lead from Lead-based Paint, Organochlorine Pesticides from Termiticides, and Polychlorinated Biphenyls from Electrical Transformers*. Revised 6/9/2006 (non-substantive revisions made 9/12/2006).

(c) Cal-EPA, 2005. *Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil.*

(d) California Regional Water Quality Control Board San Francisco Bay Region (Water Board), 2007. *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater*. November. (Note: This document states that the residential screening level of 150 mg/kg was obtained from Cal-EPA, 2005.)

Table 2. Summary of Lead Residential Screening Values Used for Different Programs within Alameda Point

Alameda Site	Screening Level mg/kg	Source	PRG-Used[a]	LeadSpread 7 Inputs			PRG-99[a]	PRG-95[a]
				Air $\mu g/m^3$	Water $\mu g/L$	Homegrown Produce		
2001 PRC	221	Petroleum Strategy, 2001	PRG-99	0.028	0.15	7%	221	323
Site 7(OU-1)	230[b]	Final ROD 2007, Final RI, 2004	PRG-95	0.0084	0.15	5.3%	158[b]	230[b]
Site 8(OU-1)	230[b]	Final ROD 2007, Final RI, 2004	PRG-95	0.0084	0.15	5.3%	158[b]	230[b]
Site 35	184	PP June 2008	PRG-99	0.055	7	7%	184	285
Site 17	150	TM, Construction Debris Piles	PRG-99	0.028	15	7%	146 (150)	247
OU-2C	197	Final RI, Sept 2008	PRG-99	0.023	5	7%	197	299

(a) Percentile value of blood lead equal to 10 $\mu g/dL$ for a child. A percentile is the value of a variable below which a certain percent of observations fall. The 95th percentile is the value below which 95 percent of the observations may be found and the 99th percentile is the value below which 99 percent of the observations may be found.

(b) Input parameters associated with the 230 mg/kg and 158 mg/kg screening values for lead as summarized in this table were obtained from site reports. However, if these input parameters are placed in the LeadSpread 7 model, values of 249 mg/kg and 362 mg/kg result for the PRG-99 and PRG-95 output, respectively.

primary tool to generate residential risk-based soil cleanup levels. The protectiveness of this value is such that it limits exposure to soil lead levels so that a typical child or group of exposed children would have an estimated risk of no more than 5 percent exceeding the 10 μg/dL blood lead level (i.e., the 95th percentile value).

The exceedance probability of no more than 5 percent was carefully examined during the proposed and final stages of the regulation contained in 40 CFR Part 745 (U.S. EPA, 1998b, 2001). According to U.S. EPA (1998b, 2001), there is no scientific evidence to assist the Agency in selecting the appropriate exceedance probability; thus, the Agency looked at several options and determined that the range of probabilities between one and five percent would be consistent with the statutory criterion for level of concern, "pose a threat". Under 40 CFR Part 75 (U.S. EPA, 2001), U.S. EPA states that:

> *"...the choice of probability is based on the Agency's interpretation of the statute and the limits of EPA's analytical tools. The Agency rejected the lowest possible probability, which is zero, because even without lead-based paint and lead contaminated soil and dust, there could be some small mathematical probability that a child could still have a blood-lead level equaling or exceeding 10 μg/dL. This is because other sources of exposure (e.g., air, water, diet, and background levels of lead) remain. Because under the statute EPA may only account for risks associated with paint, dust and soil, a zero exceedance probability would not make sense for this rule. In addition, EPA's assessment for this rule indicates that, as a practical matter, in the context of establishing on a national level the initial candidate for the hazard level, the probabilities that given environmental levels of lead ''would result'' in blood lead levels of concern, 1 percent is not distinguishable from 5 percent in estimating risks from soil lead..."*

As such, in developing remediation goals for CERCLA sites or RCRA facilities, U.S. EPA recommends that a soil lead concentration be determined so that a typical child or group of children exposed to lead at this level would have an estimated risk of no more than 5 percent of exceeding a blood lead of 10 μg/dL.

The Cal-EPA lead screening value of 150 mg/kg shown in Table 1 was derived using the LeadSpread 7 model with built-in default values for a residential scenario, assuming that 7 percent of the produce consumed would be homegrown. The DTSC schools unit lead screening level of 255 mg/kg is based on an identical residential exposure scenario as noted above with the exception that uptake of lead in homegrown produce is not considered a significant contribution of exposure for school children and is therefore not included (Cal-EPA, 2006). Cal-EPA recommends a level in soil (based on all routes of exposure) such that it limits exposure to soil lead levels so that a typical child or group of exposed children would have an estimated risk of no more than 1 percent, rather than 5 percent exceeding the 10 μg/dL blood lead level (Cal-EPA, 1992, 2005). However, the rationale for the exceedance of no more than 1 percent, similar to the U.S. EPA's justification of 5 percent, was not provided in the cited Cal-EPA guidance.

The lead screening values used for different sites within Alameda Point were derived using the LeadSpread 7 model under a residential scenario with varying inputs for air, water, and homegrown produce as listed in Table 2. The use of the 95th and 99th percentile values for the screening value also varied across the Alameda sites, with no clear reason for using one versus another.

3.0 Recommendations for Lead Screening Criteria for Petroleum Sites at Alameda Point

Although the U.S. EPA lead screening value of 400 mg/kg is derived using a more detailed blood lead model, it does not include the Cal-EPA-recommended exposure pathway for consumption of homegrown produce; thus, this value is not considered the most appropriate screening value to use at Alameda Point. Similarly, the Cal-EPA lead screening value of 255 mg/kg does not include the homegrown produce exposure pathway either; therefore, this value was not considered appropriate for screening purposes.

The Cal-EPA screening value of 150 mg/kg was based on Cal-EPA-recommended input parameters for air, water, percent homegrown produce, and respirable dust, which are not site-specific for Alameda Point, and therefore, this value was not considered to be the most appropriate value for screening at Alameda Point.

The most appropriate residential soil lead screening value would be one that included the homegrown produce exposure pathway and was based on site-specific characteristics. Thus, a residential soil lead screening value has been developed here and is proposed for evaluation of petroleum sites, and for consistency, potentially other regulated sites at Alameda Point (e.g., CERCLA IR sites), based on the examination of U.S. EPA and California guidance, guidelines, and policy for derivation of a soil lead screening value.

Derivation of this lead screening value involved:

- Using the Cal-EPA LeadSpread 7 model
- Incorporating site-specific input parameters for air, water, and percent homegrown produce
- Using a 5 percent probability level (i.e., PRG-95 in the LeadSpread 7 output)

To be consistent with guidance from the Water Board (Water Board, 2007) and Cal-EPA (2005, 2006), the Cal-EPA LeadSpread 7 model was used to derive the proposed residential soil lead screening value for Alameda Point because, as concluded by Cal-EPA (2005), LeadSpread 7 provides a good first approximation of the potential for adverse health effects in children. The IEUBK model then can be used to provide a more detailed evaluation of the potential for adverse health effects in children if the initial lead screening assessment indicates a potential concern.

The LeadSpread 7 model input and exposure parameters and output is provided as Figure 1. Site specific parameters for air, water, and percent homegrown produce were determined and entered into the LeadSpread 7 model, which is discussed in more detail below. The Cal-EPA default value for respirable dust was used because respirable dust (i.e., PM_{10} and/or $PM_{2.5}$) is not a parameter measured in nearby air monitoring stations based on information from the California Air Resources Board (CARB) (http://www.arb.ca.gov/qaweb/siteinfo.php). Cal-EPA default exposure parameters also were used as shown on Figure 1.

A value of 0.013 $\mu g/m^3$ was selected as the amount of lead in air. The value 0.013 $\mu g/m^3$ was obtained from the CARB, Technical Support Division, Annual Toxics Summary for Lead for the San Francisco-Arkansas monitoring station. This value is the maximum concentration detected for the year 2003, which is the most recent data provided on the website.

The lead in water value of 5 $\mu g/L$ is the 90th percentile value as reported in the East Bay Municipal Utility District (EBMUD) Annual Water Quality Report 2007 (EBMUD, 2007). The EBMUD regulates lead at the 90th percentile value (i.e., when the 90th percentile lead concentration in water exceeds the action level of 15 $\mu g/L$).

For the percent homegrown produce consumption input parameter, the DTSC default value for residential scenarios is 7 percent (0.07). According to Cal-EPA DTSC (2008), this value is the sum of seasonally adjusted 50th percentiles for intake by adults in the West (g/kg-day) for homegrown vegetables, fruits, and meat (Table 13-33, Exposure Factors Handbook [EFH], U.S. EPA, 1997), multiplied by 70 kg body weight and divided by food intake per day (i.e., 1900 g/day – default value in the LeadSpread 7 model). DTSC noted that if on-site gardening can be ruled out, this input parameter would be set equal to 0 percent. For the proposed Alameda Point screening value, it was assumed that only homegrown vegetables and fruits are consumed (no homegrown meat), then the 50th percentiles for intake by adults in the West (g/kg-day) for homegrown vegetables and fruits (no meats) (Table 13-33, EFH, U.S. EPA, 1997), multiplied by 60 kg body weight and divided by food intake per day (1900 g/day for adults and 1100 g/day for child as provided in LeadSpread 7). Then, from Table 13-33 in the EFH (U.S. EPA, 1997), the 50th percentile for the West for total vegetables (0.492 g/kg-day) and for total fruits (0.688 g/kg-day) yielded the following percent intakes for adult and child receptors:

- Sum = 1.18 g/kg-day x 60 kg divided by 1900 g/day = 4 percent adult
- Sum = 1.18 g/kg-day x 60 kg divided by 1100 g/day = 6 percent child

Because the child receptor is the focus of the lead evaluation, 6 percent was used at the input parameter. Note that although DTSC used a body weight of 70 kg to derive the default value of 7 percent, the EFH states to use 60 kg, not 70 kg when converting g/kg-day (see page 13-9 of the EFH 1997); thus the 60 kg body weight was used in these calculations.

Cal-EPA (1992, 2005) recommends a soil lead level that would have a risk of no more than 1 percent exceeding the 10 µg/L blood lead level, but does not provide justification for this level. On the other hand, as stated above, the exceedance probability (i.e., no more than 5 percent) was carefully examined by U.S. EPA during the proposed and final stages of 40 CFR Part 745 (U.S. EPA, 1998b, 2001). U.S. EPA found that as a practical matter when establishing a hazard level the probabilities that given environmental levels of lead would result in blood lead levels of concern, 1 percent is not distinguishable from 5 percent in estimating risks from soil lead. Therefore, a soil lead level that would have an estimated risk of no more than 5 percent exceeding the 10 µg/L blood lead level (i.e., 95th percentile value), rather than 1 percent (i.e., 99th percentile value) was used to select the soil lead screening value, which is consistent with U.S. EPA (1994b and 1998a) recommendations.

The proposed residential soil lead screening value for Alameda Point is 319 mg/kg as shown on Figure 1.

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LEAD RISK ASSESSMENT SPREADSHEET

CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

USER'S GUIDE to version 7

INPUT	
MEDIUM	LEVEL
Lead in Air (ug/m^3)	0.013
Lead in Soil/Dust (ug/g)	
Lead in Water (ug/l)	5
% Home-grown Produce	6%
Respirable Dust (ug/m^3)	1.5

OUTPUT	Percentile Estimate of Blood Pb (ug/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g)
BLOOD Pb, ADULT	0.5	1.0	1.1	1.4	1.6	950	1381
BLOOD Pb, CHILD	0.8	1.5	1.8	2.2	2.5	211	319
BLOOD Pb, PICA CHILD	0.8	1.5	1.8	2.2	2.5	132	200
BLOOD Pb, OCCUPATIONAL	0.5	1.0	1.1	1.4	1.6	4372	6361

EXPOSURE PARAMETERS			
	units	adults	children
Days per week	days/wk	7	
Days per week, occupational		5	
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5700	2900
Skin area occupational	cm^2	2900	
Soil adherence	ug/cm^2	70	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001	
Soil ingestion	mg/day	50	100
Soil ingestion, pica	mg/day		200
Ingestion constant	(ug/dl)/(ug/day)	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	20	6.8
Inhalation constant	(ug/dl)/(ug/day)	0.082	0.192
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	1.1
Lead in market basket	ug/kg	3.1	
Lead in home-grown produce	ug/kg	0.0	

Click here for REFERENCES

PATHWAYS						
ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	3.8E-5	0.00	0%	1.4E-5	0.00	0%
Soil Ingestion	8.8E-4	0.00	0%	6.3E-4	0.00	0%
Inhalation, bkgrnd		0.02	4%		0.02	3%
Inhalation	2.5E-6	0.00	0%	1.8E-6	0.00	0%
Water Ingestion		0.28	54%		0.28	53%
Food Ingestion, bkgrnd		0.22	42%		0.23	44%
Food Ingestion	2.1E-3	0.00	0%			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	5.6E-5	0.00	0%		0.00	0%
Soil Ingestion	7.0E-3	0.00	0%	1.4E-2	0.00	0%
Inhalation	2.0E-6	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.02	2%		0.02	2%
Water Ingestion		0.32	38%		0.32	38%
Food Ingestion, bkgrnd		0.51	60%		0.51	60%
Food Ingestion	4.8E-3	0.00	0%		0.00	0%

INPUT PARAMETER NOTES

Site Specific Info:
The value 0.013 ug/m3 was obtained from the California Air Resources Board (CARB), Technical Support Division - Annual Toxics Summary for Lead for the San Francisco-Arkansas monitoring station. This value is the maximum concentration detected for the year 2003 (the most recent data provided on the website)

Site-specific value:
value = 5 ug/L, based on the East Bay Municipal Utility District 2007 Annual Water Quality Report. This value is the 90th percentile level detected.

Human and Ecological Risk Div said in an email, "The default value for residential scenarios is 7% (0.07), This value is the sum of seasonally adjusted 50th percentiles for intake by adults in the West (g/kg-day) for homegrown vegetables, fruits, and meat (Table 13-33, Exposure Factors Handbook, USEPA, 1997) , multiplied by 70 kg body weight and divided by food intake per day. If on-site gardening can be ruled out, set this cell to 0%. Otherwise, the default is 7 %. This pathway is not included in calculating total exposure for occupational scenarios."

If one assumes that only homegrown vegies and fruits are consumed, then the 50th percentiles for intake by adults in the West (g/kg-day) for homegrown vegetables and fruits (no meats) (Table 13-33, Exposure Factors Handbook, USEPA, 1997) , multiplied by 70 kg body weight and divided by food intake per day, results in a value of 4.3?%.
From Table 13-33 in the EFH, 50th percentile for West:
total vegies = 0.492
total fruit = 0.688
Sum = 1.18 g/kg-day x 60 kg divided by 1900 g/day = 4% adult
Sum = 1.18 g/kg-day x 60 kg divided by 1100 g/day = 6% child
average of the two percentages = 5%
Note: the EFH states to use 60kg, not 70 kg when converting g/kg-day (see

Human and Ecological Risk Div:
Default value is 1.5 ug/m^3, based on Soil Screening Guidance (U.S. EPA, 1996). May be replaced with site-specific data.

Figure 1. LeadSpread 7 Output for Proposed Lead PRC in Soil Including Homegrown Produce

ATTACHMENT 3

Calculation of Updated Preliminary Remediation Criteria for Total Petroleum Hydrocarbon Fractions

Calculation of Updated Preliminary Remediation Criteria for Total Petroleum Hydrocarbon Fractions

PRCs for the TPH fractions (-G, -D/J, -MO) in the original 2001 Petroleum Strategy were values derived for the Presidio of San Francisco ("Presidio" values) (Montgomery Watson, 1996). The Presidio values were developed using a surrogate approach whereby the TPH fractions were assigned an appropriate surrogate chemical for which a risk-based action level had already been determined. The TPH compositional assumptions and surrogate chemicals for the Presidio values are summarized in Table 1. Risk-based action levels for the surrogate chemicals were derived for residential and non-residential receptors.

Table 1. Compositional Assumptions and Surrogate Chemicals Used to Derive the Presidio Values[(a)]

TPH Fraction	Compositional Assumption (by weight)	Surrogate Chemical
TPH-G	Aliphatic (60%)	n-Hexane
TPH-J/D	Aromatic (35%)	Naphthalene
TPH-MO	Aromatic (25%)	Naphthalene

(a) Compositional assumptions and surrogate chemicals originate from the Presidio report (Montgomery Watson, 1996).

The PRCs for the TPH fractions were calculated by dividing the risk-based action level of the surrogate compound by the percent (in terms of weight) of the fraction (aliphatic or aromatic) the surrogate compound represents as follows:

$$\text{TPH PRC} = \frac{\text{Surrogate Compound Action Level}}{\text{TPH relative fraction}} \qquad \text{(Equation 1)}$$

Consistent with the overall objectives of the updated Petroleum Strategy, the TPH PRCs were revised to reflect the changes in toxicity values (U.S. EPA, 2009) since the original Presidio numbers were published. The RSLs for n-hexane and naphthalene now replace the risk-based action levels that were developed for those chemicals at the Presidio. Note that neither of these chemicals are included in Department of Toxic Substances Control (DTSC) Human Health Risk Assessment (HHRA) Note 3 (2009) as requiring comparison criteria different from the RSLs. Use of the RSLs for these surrogate chemicals provides consistency in the use of toxicity values and exposure assumptions across all soil PRCs.

Table 2 summarizes the RSLs for the surrogate compounds. Note that the RSL derived for the non-carcinogenic endpoint for naphthalene is used to assess TPH. Cancer effects for TPH are not directly assessed, but rather are captured in the assessment of the individual constituents analyzed for and evaluated under the VOC and PAH analyses, which are designated carcinogens (MADEP, 2002; TPH Criteria Working Group [TPHCWG], 1997). The updated TPH PRCs derived using Equation (1) and substituting the U.S. EPA RSL for the "surrogate compound action level" are summarized in Table 3.

Table 2. Summary of RSLs for Surrogate Compounds

Compound	USEPA RSL (mg/kg)[a]	
	Residential	Industrial[b]
n-hexane	570	2,600
naphthalene	150	670

(a) Residential and non-residential PRCs in soil have been updated to be consistent with U.S. EPA RSLs issued in April 2009 (http://www.epa.gov/region09/superfund/prg/index.html)

(b) Industrial RSLs are used to represent the "non-residential" PRCs in the updated Petroleum Strategy.

Table 3. Updated PRCs for TPH Fractions

TPH Fractions	TPH Relative Compositional Fraction	Surrogate Compound	TPH PRC (mg/kg)	
			Residential	Non-residential
TPH-G	0.6	n-hexane	950	4,333
TPH-J/D	0.35	naphthalene	429	1,914
TPH-MO	0.25	naphthalene	600	2,680

References

Massachusetts Department of Environmental Protection. 2002. *Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of the MADEP VPH/EPH*. Policy #WSC-02-411. October 31

Montgomery Watson. 1996. Fuel *Product Action Level Development Report, Presidio of San Francisco, California*. October.

Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG). 1997. *Development of Fraction Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for Total Petroleum Hydrocarbons (TPH)*. Total Petroleum Hydrocarbon Working Group. Volume 4. Amherst Scientific Publishers, Amherst, Massachusetts, ISBN 1-884-940-13-7.

U.S. EPA, 2009. *Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites*. RSL Table Update. April.

ATTACHMENT 4

San Francisco Bay Regional Water Quality Control Board (Water Board). 2003. Letter from Judy Huang (Water Board) to Glenna M. Clark (Department of the Navy). July 21

California Regional Water Quality Control Board

San Francisco Bay Region

Winston H. Hickox
Secretary for Environmental Protection

Internet Address: http://www.swrcb.ca.gov
1515 Clay Street, Suite 1400, Oakland, California 94612
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Gray Davis
Governor

Date: JUL 2 1 2003
File No. 2199.9285 (JCH)

Ms. Glenna M. Clark
Remedial Project Manager
Department of the Navy
Southwest Division
Naval Facilities Engineering Command
1230 Columbia Street, Suite 1100
San Diego, California 92101-8517

SUBJECT: CONCURRENCE THAT GROUNDWATER MEETS THE EXEMPTION CRITERIA IN THE STATE WATER RESOURCES CONTROL BOARD SOURCE OF DRINKING WATER POLICY RESOLUTION 88-63, AND SAN FRANCISCO BAY REGIONAL WATER QUALITY CONTROL BOARD RESOLUTION 89-39 FOR GROUNDWATER WEST OF SARATOGA STREET AT ALAMEDA POINT, CITY OF ALAMEDA, ALAMEDA COUNTY

Dear Ms. Clark:

This is in response to the U.S. Navy's July 10, 2003, request for an exemption from the municipal and domestic water supply designation in accordance to San Francisco Bay Regional Water Quality Control Board (Regional Board) Resolution 89-39 and State Water Resources Control Board (State Board) Source of Drinking Water Policy, Resolution 88-63.

Staff has reviewed the accompany report titled "Determination of The Beneficial Uses of Groundwater, Alameda Point, Alameda, California" (Report) dated July 2000, and finds that the quality and nature of the groundwater in the first and second water bearing zones beneath Alameda Point west of Saratoga Street are such that these waters are not potential sources of drinking water pursuant to State Board Resolution No. 88-63 and Regional Board Resolution 89-39. Furthermore, as the U.S. Navy demonstrated in the Report, the artificial land surface west of Saratoga Avenue lies entirely within what was the San Francisco Bay prior to the early 1900's.

Staff concurs with the U.S. Navy that the groundwater in the first and second water bearing zones west of Saratoga Avenue are not potential sources of drinking water, based on the high total dissolved solids (TDS) data. However, the U.S. Navy must consider all other potential beneficial uses of the groundwater west of Saratoga Avenue as outlined in the 1995 Water Quality Control Plan, San Francisco Bay Regional Board.

Hydrogeology of the Subsurface at Alameda Point west of Saratoga Avenue

There are two water-bearing zones at Alameda Point west of Saratoga Avenue. The first is an unconfined aquifer composed of artificial fill material from just below ground surface to the top of the Bay Sediment Unit. The natural groundwater gradient for the shallow fill slopes toward the Bay. The Bay Sediment Unit west of Saratoga Avenue is about 10 to 110 feet thick. The second water-bearing zone is a semi-confined aquifer composed of the lower portion of the Bay Sediment Unit, the Merrit Sand Formation (where present), and the upper unit of the San Antonio Formation. Beneath the second water bearing zone is the Alameda Formation.

Total Dissolved Solids Levels in the Shallow Fill Aquifer at Alameda Point west of Saratoga Avenue

The TDS exemption criteria in the State Board's Sources of Drinking Water Policy, Resolution No. 88-63, states that all groundwater in California are considered a potential drinking water source unless the TDS levels exceed 3,000 mg/L, and it is not reasonably expected by the Board that the groundwater could supply a public water system. The first and second water bearing zones at Alameda Point west of Saratoga Avenue contain water with high TDS contents due to naturally occurring saltwater intrusion. Information submitted by the U.S. Navy indicates that the maximum TDS concentrations in the first water bearing zone range from 80 – 52,000 mg/L and the maximum TDS concentrations in the second water bearing zone range from 1,600 – 78,600 mg/L.

Additional Issues

While the U.S. Navy has adequately demonstrated that the groundwater in the first and second water bearing zones are brackish and their TDS concentrations exceed the State Board's Sources of Drinking Water Policy exemption criteria, there are several other issues that must still be addressed. Other potential groundwater beneficial uses as outlined in the 1995 Basin Plan (Table 2-9), still apply to Alameda Point west of Saratoga Avenue (i.e. agricultural supply, industrial process supply, and industrial service supply).

Pursuant to State Board Resolution 92-49, the U.S. Navy must still demonstrate that 1) adequate source removal has occurred, 2) the plume or plumes have been adequately defined both laterally and vertically, and 3) a long-term monitoring program is established to verify that the plume or plumes are stable and will not impact ecological receptors or human health (e.g. from volatilization into trenches and buildings).

Please contact me at (510) 622-2363 or email jch@rb2.swrcb.ca.gov if you have any questions.

Verv Truly Yours,

Judy C. Huang

Judy C. Huang, P.E.
Associate Water Resource Control Engineer
Groundwater Protection and Waste Containment Division

cc:

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ATTACHMENT 5

Summary of Johnson and Ettinger Input Parameters Used to Calculate the Vapor Intrusion Preliminary Remediation Criteria for Groundwater

Table 1. Summary of Input Parameters to the J&E Spreadsheet for Development of Vapor Intrusion PRC

Input Parameters	Value	Source[(a)]
Average soil/groundwater temperature (°C)	24	DTSC Default
Soil gas sampling depth (cm)	213 (7 feet)	Site-specific
Soil type	Sandy loam (SL)	Site-specific
Soil vapor permeability (cm^2)	1.00E-08	DTSC Default for SL
Soil dry bulk density (g/cm^3)	1.5	DTSC Default for SL
Soil total porosity (unitless)	0.43	Site-specific
Soil water-filled porosity (unitless)	0.15	Site-specific
Depth below grade to bottom of enclosed floor space (cm)	15	
Average vapor flow rate in to building (L/m)	5	DTSC Default
Residential exposure duration (years)	30	DTSC Default
Residential exposure frequency (days)	350	DTSC Default
Nonresidential exposure duration (years)	25	DTSC Default
Nonresidential exposure frequency (days)	250	DTSC Default

(a) Site-specific assumptions were obtained from the 2001 Petroleum Strategy.

GW-SCREEN
Version 3.0; 04/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

DTSC
Vapor Intrusion Guidance
Interim Final 12/04
(last modified 2/4/09)

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
71432		Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type *directly above* water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	213	SL	24	5

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SL			SL	1.5	0.43	0.25

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Figure 1. Example: Vapor Intrusion PRC Calculation for Benzene – "Data Enter"

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
198	0.180	0.540	6.07E-09	0.619	3.76E-09	25.00	0.387	0.067	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
3.39E+04	1.00E+06	5.00E-03	15	7,977	5.29E-03	2.17E-01	1.80E-04	1.58E-03	8.02E-05	4.70E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
198	15	2.17E+02	1.25	8.33E+01	1.58E-03	5.00E+03	7.12E+45	6.81E-05	1.48E-02	7.8E-06	3.0E-02

END

Figure 2. Example: Vapor Intrusion PRC Calculation for Benzene – "Intercalcs"

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
2.11E+01	2.12E+03	2.11E+01	1.79E+06	2.11E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

END

Figure 3. Example: Vapor Intrusion PRC Calculation for Benzene – "Results"

ATTACHMENT 6

Responses to Comments on the Draft Technical Memorandum, Update to Preliminary Remediation Criteria and Closure Strategy for Petroleum-Contaminated Sites, Petroleum Program at Alameda Point, Alameda, California Dated April 2009

Responses to Comments on the Draft Technical Memorandum, Update to Preliminary Remediation Criteria and Closure Strategy for Petroleum-Contaminated Sites, Petroleum Program at Alameda Point, Alameda, California Dated April 2009

Comment Number	Page/Section Numbers	Comment	Response
Comments by Mr. John West (San Francisco Regional Water Quality Control Board [Water Board]) dated April 29, 2009			
1.		Please explain the pros and cons considered to condense the original four category strategies for potential CAA and non-CAA petroleum-impacted soil and groundwater sites to just one strategy (Page 1, last paragraph).	In reviewing the four process flow diagrams in the 2001 Petroleum Strategy, the Navy determined that there were many similarities between each that could be consolidated into a single process flow diagram. Important elements that were presented in any one of the 2001 process flow diagrams have been included in the 2009 update. The primary reason only one process flow diagram has been presented in the 2009 update is to establish a clear and consistent process that can be applied at each petroleum site to evaluate site conditions and potential risks to human health and the environment. Additionally, the Petroleum Strategy Update will be used to evaluate each open petroleum site that has been identified in historical documentation, including all underground storage tank sites (USTs), aboveground storage tank sites (ASTs), and associated piping, that contained petroleum only. If new petroleum sites are identified in the future, they will be evaluated using the same Strategy as well.
2.		Could 1,2-dichloroethane (1,2-DCA) also be a contaminant of concern at Alameda Point? 1,2-DCA historically was used as an anti-knock in leaded fuels. It is not included in the list of chemicals of potential concern in Table 1.	It is possible for 1,2-DCA to be a Chemical of Potential Concern (COPC) at sites impacted by light distillates such as gasoline. 1,2-DCA was a lead-based antiknock additive that was used between the 1920s and 1980s in leaded gasoline. It has been added to Table 1, and applicable ESLs and PRCs have been incorporated into Tables 2 and 3, respectively.
3.		Clarify how subsurface sources of petroleum (e.g., underground storage tanks, piping, oil/water separators) fit into the petroleum strategy. Based on the Steps described in the text and shown on Figure 1, only surface staining is being used to determine areas of investigation.	Subsurface sources of petroleum are addressed in Steps 4 through 6 (Screen Data Against ESLs, Screen Data Against PRC, and Confirm Adequate Site Characterization, respectively). Step 1 is intended to address visible surface contamination, and Step 2 is intended to address free product. Steps 4 through 6 address all site data, including soil and groundwater samples collected in the subsurface. To address the comment, Step 6 has been revised to include

Responses to Comments on the Draft Technical Memorandum, Update to Preliminary Remediation Criteria and Closure Strategy for Petroleum-Contaminated Sites, Petroleum Program at Alameda Point, Alameda, California Dated April 2009

Comment Number	Page/Section Numbers	Comment	Response
Comments by Mr. John West (San Francisco Regional Water Quality Control Board [Water Board]) dated April 29, 2009 (Continued)			
3 cont.			"known or potential sources" to clarify that adequate site characterization addresses potential subsurface contamination and not only surficial contamination described in Step 1.
4.		Clarify what is meant by "site data" in Step 2, screening for the presence of free product. Because Step 1 includes only investigation for surface staining, it is not clear if the Navy intends to evaluate subsurface data or only data from shallow surface areas.	Site data includes all data related to the site. Typically this includes surface soil, subsurface soil, and groundwater data, but may also include anecdotal evidence such as fuel inventory records and historical observations recorded by Navy personnel. Sampling data would be compared to the free product (FP) screening criteria to determine whether there is a reason to suspect FP to be present.
5.		Define "significantly" as it relates to co-mingling of contaminants and clarify how the Navy will determine whether "significant" co-mingling has occurred.	A qualitative evaluation of existing data and ongoing CERCLA activities at a particular site would determine whether "significant co-mingling" of petroleum hydrocarbons and CERCLA contaminants exists at a particular site. The reason for mentioning the potential for co-mingled contaminants is to ensure the investigator(s) and project stakeholders realize that there will need to be direct coordination between the Petroleum Program and CERCLA Program.
6.		Clarify what measures would be in place should property use change. Specifically, data evaluation and risk management are based on proposed site use. Clarify how the Navy plans to address a site if the use changes in the future to a more sensitive receptor (e.g., corrective action/closure granted for commercial site but use changes in 10 years to residential).	If a site is closed with restrictions (e.g., non-residential land use), then an appropriate deed restriction will be required upon property transfer. Additionally, the Navy is responsible for evaluating, and if necessary remediating each site based on the planned future use as indicated in the Alameda Point Preliminary Development Concept (February 2006). The effect of a change to the planned future use would be the responsibility of the new owner.
7.		Provide justification for why the receptors, exposure parameters, and pathways used to develop PRCs for the Presidio are "similar to those expected at Alameda Point." No information regarding the Presidio is presented; therefore, no assessment on the validity of the statement regarding the similarities of the two sites and expected exposures can be made by the agencies.	A more detailed review of the development of the Presidio action levels was conducted. The Presidio values were developed using a surrogate approach whereby the TPH fractions were assigned an appropriate surrogate chemical for which a risk-based action level had been determined (see Table 1 inset below). Risk-based action levels for the surrogate chemicals were derived for residential and non-residential receptors based on the potential completed exposure pathways and exposure assumptions for these receptor groups at the Presidio.

<table>
<tr><th>Comment Number</th><th>Page/Section Numbers</th><th>Comment</th><th>Response</th></tr>
<tr><td colspan="4">Comments by Mr. John West (San Francisco Regional Water Quality Control Board [Water Board]) dated April 29, 2009 (Continued)</td></tr>
<tr><td>7 cont.</td><td></td><td></td><td>

Table 1. Compositional Assumptions and Surrogate Chemicals Used to Derive the Presidio Values

<table>
<tr><th>TPH Fraction</th><th>Compositional Assumption</th><th>Surrogate Chemical</th></tr>
<tr><td>TPH-G</td><td>Aliphatic (60%)</td><td>n-Hexane</td></tr>
<tr><td>TPH-J/D</td><td>Aromatic (35%)</td><td>Naphthalene</td></tr>
<tr><td>TPH-MO</td><td>Aromatic (25%)</td><td>Naphthalene</td></tr>
</table>

The PRCs for the TPH fractions were calculated by dividing the risk-based action level of the surrogate chemical by the percent (in terms of weight) of the fraction (aliphatic or aromatic) the surrogate chemical represented as follows:

$$\text{TPH PRC} = \frac{\text{Surrogate Chemical Action Level}}{\text{TPH relative fraction}}$$

Although the exposure parameters and potentially complete exposure pathways included in the Presidio values are similar to those expected at Alameda Point, the toxicity values were out of date. Therefore, consistent with the overall objectives of the TPH Strategy Update, the TPH PRCs were updated to reflect changes in toxicity values.

The RSLs for n-hexane and naphthalene now replace the risk-based action levels that were developed for those chemicals at the Presidio. Note that neither of these chemicals are included in Department of Toxic Substances Control (DTSC) Human Health Risk Assessment (HHRA) Note 3 (2009) as requiring comparison criteria different from the RSLs. Use of the RSLs for these surrogate chemicals provides consistency in the use of toxicity

</td></tr>
</table>

Responses to Comments on the Draft Technical Memorandum, Update to Preliminary Remediation Criteria and Closure Strategy for Petroleum-Contaminated Sites, Petroleum Program at Alameda Point, Alameda, California Dated April 2009

Comment Number	Page/Section Numbers	Comment	Response
Comments by Mr. John West (San Francisco Regional Water Quality Control Board [Water Board]) dated April 29, 2009 (Continued)			
7 cont.			values and exposure assumptions across all soil PRCs. See Table 3 and Attachment 3 for a listing and description of the updated PRCs for the TPH fractions.
8.		Revise Figure 1 and Step 1 to address additional subsurface sources of petroleum. Figure 1 follows the Steps outlined in the text. However, it is missing the subsurface sources in Step 1.	Please refer to the response to Water Board Comment #3 to see how Figure 1 and the text describing Step 1 has been revised to address this comment.
9.		On a separate note, it would be interesting to see if actual groundwater data fits the model TetraTech used to develop the marine ecological receptors (Table 4). Specifically, do concentrations of petroleum compounds/constituents attenuate in the manner expected based on the distance to shoreline?	The linear models previously developed by TetraTech and Parsons that were used to calculate the distance-corrected PRCs for groundwater discharging to surface water are not currently available to conduct the evaluation brought up in the Water Board comment.
Review Comments by Mr. Peter Russell (Alameda Reuse and Redevelopment Authority Consultant) dated May 18, 2009			
1		The primary comment I have concerning the draft Petroleum Strategy Update concerns lead. The draft document proposes a residential PRC for lead of 319 mg/kg. This value is derived in a draft report that appears as an appendix to the update. The proposed PRC is so high largely because the 95th percentile was used, rather than the 99th percentile that is used at most other Alameda Point sites (although not all), including the existing Petroleum Strategy that is being updated. I am concerned that this PRC is laxer than that used for most of the CERCLA cleanup at Alameda Point. If this high value is used for the Navy's cleanup, California environmental regulators may seek subsequent cleanup from the transferee to satisfy state requirements.	Screening levels and remediation goals for lead in residential soils vary across sites at Alameda Point. Therefore, the Navy compared the various lead values previously developed for use at Alameda Point, as well as the default lead screening values recommended by U.S. EPA and Cal-EPA. This evaluation is provided in the Lead Tech Memo provided as Attachment 2 in the Petroleum Update Tech Memo. For the time being the Navy has decided to identify the residential soil lead PRC as "TBD" in Table 3 of the updated Petroleum Strategy until additional information is available from DTSC's review referenced in HHRA Note 3, and a consensus can be reached with the regulatory agencies. Based on the evaluation described above a residential soil lead screening value was developed and proposed for use at Alameda Point petroleum sites. The proposed value was 319 mg/kg and its use is supported in the Lead Tech Memo. As discussed in the Lead Tech Memo, residential soil lead screening values used at Alameda Point range from 150 mg/kg up to 400 mg/kg, depending on exposure assumptions and input parameter values used to

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1 cont.		Before keeping this draft lead PRC for the final version of this document, please verify that state regulators will remain accepting of this cleanup level after transfer.	derive the screening value. The lead screening values used for different sites within Alameda Point were derived using the LeadSpread 7 model under a residential scenario with varying inputs for air, water, and homegrown produce. The use of the 95th and 99th percentile values for the screening value also varied across the Alameda sites, with no clear technical justification for using one versus another. Guidance from U.S. EPA provided direction for use of the 95th percentile by stating that the protectiveness of this value is such that it limits exposure to soil lead levels so that a typical child or group of exposed children would have an estimated risk of no more than 5 percent exceeding the 10 µg/dL blood lead level (i.e., the 95th percentile value). The exceedance probability of no more than 5 percent was carefully examined during the proposed and final stages of the regulation contained in 40 CFR Part 745 (U.S. EPA, 1998, 2001). According to U.S. EPA (1998, 2001), there is no scientific evidence to assist the Agency in selecting the appropriate exceedance probability; thus, the Agency looked at several options and determined that the range of probabilities between one and five percent would be consistent with the statutory criterion for level of concern, "pose a threat". Under 40 CFR Part 75 (U.S. EPA, 2001), U.S. EPA states that: *"…the choice of probability is based on the Agency's interpretation of the statute and the limits of EPA's analytical tools. The Agency rejected the lowest possible probability, which is zero, because even without lead-based paint and lead contaminated soil and dust, there could be some small mathematical probability that a child could still have a blood-lead level equaling or exceeding 10 µg/dL. This is because other sources of exposure (e.g., air, water, diet, and background levels*

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1 cont.			*of lead) remain. Because under the statute EPA may only account for risks associated with paint, dust and soil, a zero exceedance probability would not make sense for this rule. In addition, EPA's assessment for this rule indicates that, as a practical matter, in the context of establishing on a national level the initial candidate for the hazard level, the probabilities that given environmental levels of lead ''would result'' in blood lead levels of concern, 1 percent is not distinguishable from 5 percent in estimating risks from soil lead..."* As such, in developing remediation goals for CERCLA sites or RCRA facilities, U.S. EPA recommends that a soil lead concentration be determined so that a typical child or group of children exposed to lead at this level would have an estimated risk of no more than 5 percent of exceeding a blood lead of 10 µg/dL. The Cal-EPA lead screening value of 150 mg/kg was derived using the LeadSpread 7 model with built-in default values for a residential scenario, assuming that 7 percent of the produce consumed would be homegrown. Cal-EPA recommends a level in soil (based on all routes of exposure) such that it limits exposure to soil lead levels so that a typical child or group of exposed children would have an estimated risk of no more than 1 percent, rather than 5 percent exceeding the 10 µg/dL blood lead level (Cal-EPA, 1992, 2005). The DTSC LeadSpread model calculates both a 95^{th} and 99^{th} percentile PRG. However, the rationale for the exceedance of no more than 1 percent, similar to the U.S. EPA's justification of 5 percent, was not provided in the cited Cal-EPA guidance or any other information the Navy has reviewed from Cal-EPA. On May 6, 2009, DTSC issued Human Health Risk Assessment Note Number 3 noting that OEHHA was evaluating a change in

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1 cont.			the development of a child-specific benchmark in the blood lead concentration, and that updated recommendations regarding evaluation of exposure to lead would be forthcoming pending an internal review. In the interim, DTSC is calling for use of the LeadSpread model in evaluating multimedia exposures to lead for the residential land use scenario using the predicted 99th percentile estimate of blood lead for a child. For the time being the Navy has decided to identify the residential soil lead PRC as "TBD" in Table 3 of the updated Petroleum Strategy until additional information is available from DTSC's review referenced in HHRA Note 3, and a consensus can be reached with the regulatory agencies.
Additional Review Comment by Mr. John West (Water Board) dated May 19, 2009			
1.		I agree with Peter's concern and as we've discussed before, I'm also not comfortable with the proposed lead levels in the Petroleum Strategy Update of 319 mg/kg. As I have stated repeatedly before though, the lead clean-up levels at Alameda Point should be consistent with other CERCLA sites.	Please see the response to Mr. Peter Russell's comment above regarding the residential soil PRC for lead. The only other consistency-related issue associated with the CERCLA Program and Petroleum Program is to decide whether a subset of polycyclic aromatic hydrocarbons (PAHs) should be evaluated by using the benzo(a)pyrene (BaP) equivalent or not. Upon further review it has been determined that the BaP equivalent approach has been applied under the Alameda Point CERCLA Program during site characterization efforts to determine if additional sampling is required. However, under the CERCLA Program, individual PAHs (and not the BaP equivalent) are used to assess potential risks to future receptors. Relevant screening criteria for individual PAHs exist in the form of U.S. EPA RSLs and DTSC HERD-modified criteria included in Note 3 (dated May 6, 2009). The Navy proposes to use these criteria for individual PAHs as PRCs in the Petroleum Strategy as opposed to evaluating the BaP equivalent because the equivalent would only address a subset of PAHs, and only apply to soils. By proceeding directly to an evaluation of individual PAHs, a consistent and technically appropriate approach can be applied for all PAHs in soil and groundwater. Table 3 of the Petroleum

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1 cont.			Strategy, which presents the PRCs for soil and groundwater, has been updated to reflect the most current PRCs for individual PAHs.
Review Comment by Ms. Dot Lofstrom (California Department of Toxic Substances Control [DTSC]) dated May 20, 2009			
1.		DTSC does not support a soil lead concentration of 319 mg/kg for unrestricted (residential) land use, nor the use of the 95th percentile rather than the 99th percentile value from the DTSC LeadSpread model. The California-modified Region 9 PRG (used before the Regional Screening Levels (RSLs) came out) was 150 mg/kg for residential, and the California Human Health Screening Level (CHHSL) for residential is 150 mg/kg as well. As the Navy is aware, HERD is currently reviewing the RSLs. Here is the HERD guidance for lead screening values in soil from the RSL review. "... the DTSC Lead Risk Assessment Spreadsheet (LeadSpread) should be used to evaluate multimedia exposures to lead for the residential land use scenario using the predicted 99th percentile estimate of blood lead for a child. If lead is a COPC in soil only, HERD recommends using the 2004 U.S. EPA residential soil Cal-modified PRG which is 150 mg/kg. This value is similar to the OEHHA residential soil CHHSL for lead. DTSC's LeadSpread is currently under revision to ensure that the model is adequately protective of women of child-bearing age. In the interim,	Please see the response to Mr. Peter Russell's comment above. The Navy would appreciate it if DTSC could provide the technical rationale for selecting the 99^{th} percentile value from the LeadSpread model as opposed to the 95^{th} percentile in light of the U.S. EPA's assessment of the issue which concluded that, "*1 percent is not distinguishable from 5 percent in estimating risks from soil lead*"

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1 cont.		DTSC's LeadSpread should not be used at this time to evaluate receptors other than children. Rather, HERD recommends using the 2004 U.S. EPA industrial PRG for lead (800 mg/kg) to evaluate the industrial/commercial scenario and adult exposures to lead. This value is the same as the 2008 RSL for soil under the industrial scenario."	

References:

California EPA (Cal-EPA). 1992. *Assessment of Health Risks from Inorganic Lead in Soil.* Office of the Science Advisor Guidance Chapter 7. August.

California EPA (Cal-EPA). 2005. Human-Health-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil (November 2004, updated January 2005): California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, http://www.oehha.org/risk/Sb32soils05.html.

U.S. Environmental Protection Agency (U.S. EPA). 1998. 40 CFR Part 745, "Lead; Identification of Dangerous Levels of Lead; Proposed Rule," *Federal Register* Vol. 63, No. 106. June 3.

U.S. Environmental Protection Agency (U.S. EPA). 2001 40 CFR Part 745, "Lead; Identification of Dangerous Levels of Lead; Final Rule," *Federal Register* Vol. 66, No. 4. January 5.